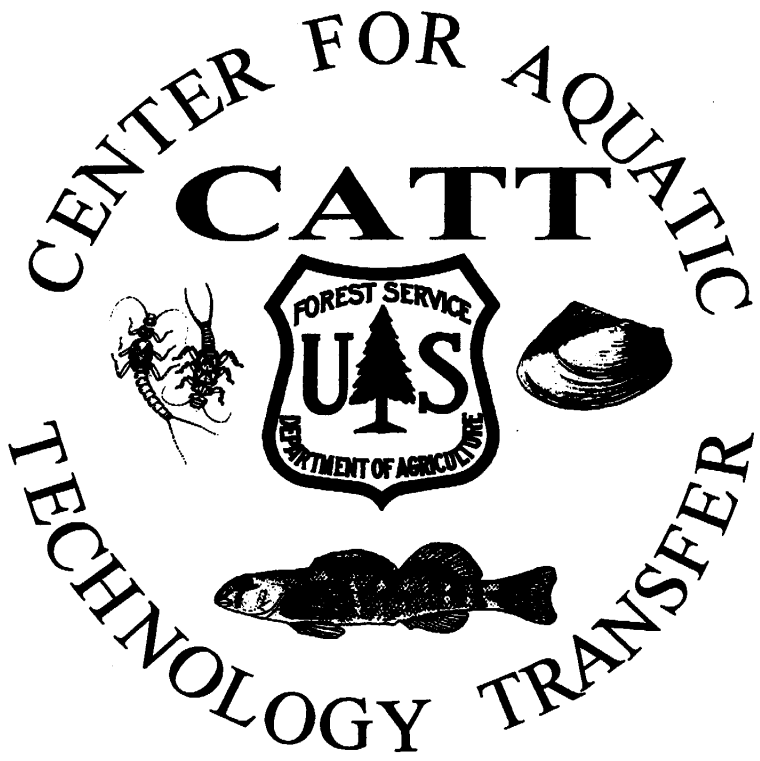
Inventory and Assessment of Wood Debris Loading in Streams Following a Natural Event, Clinch Ranger District, Wise, VA



United States Department of Agriculture Forest Service
Center for Aquatic Technology Transfer
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Virginia Polytechnic Institute and State University
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Introduction

We quantified the location and abundance of wood in eight sections of stream in Southwest Virginia after a natural blow-down event. In July of 1998, several small wind storms (tornadoes) touched down just north of and below Stone Mountain on the Clinch Ranger District near Wise, Virginia. The stream sections ran through six areas classified as blow-downs by Clinch Ranger District personnel. Almost all trees within each blow-down section were either uprooted or broken off near the base. Four different perennial streams were included in this study. We identified and mapped the location of all fallen trees within the 100-year flood plain for each stream. We also estimated the diameter, orientation, and height above channel for each tree. Where possible, a reference section was mapped for each blow-down site to compare impacted versus non-impacted stream sections.

This administrative study had three objectives:

1) describe the loading and orientation of wood debris in streams draining lands subjected to a catastrophic blow-down,

2) establish a baseline for monitoring should a proposed salvage operation be approved,

3) identify opportunities for stream habitat enhancement associated both with the blow-down and non-impacted reference sites.

Study Sites

Four streams were chosen for the study; two unnamed tributaries of Chimney Rock Fork, one unnamed tributary of Stony Creek, and one unnamed tributary of Staunton Creek were included in the survey. The study site on the more northern unnamed tributary of Chimney Rock Fork (Site One), measured 402.1 meters (Figure 1). The remaining unnamed tributary of

Chimney Rock Fork included in the study (Site Two), measured 543.4 meters (Figure 2). The unnamed tributary of Stony Creek ran through three separate blow-down areas and is divided into a 115.8 meter section (Site Three A), a 235.8 meter section (Site Three B), and a 183.7 meter section (Site Three C) (Figure 3). The unnamed tributary of Staunton Creek (Site Four) is divided into three sections. This includes 135.7 meters of the main channel (Figure 4), 150.6 meters of the left fork (Figure 5), and 182.3 meters of the right fork (Figure 6).

Where possible, a reference section was mapped for each site. Site one has a 300-meter upper reference (Figure 1). Site two has a 120-meter upper reference and a 180-meter lower reference (Figure 2). Site three A has a 120-meter lower reference (Figure 3). Site three B has a 100-meter lower reference that is directly above Site three A (Figure 3). Site three C has a 110-meter lower reference that is directly above Site three B (Figure 3). Site four main channel has a 240-meter lower reference (Figure 4). Neither the left fork nor the right fork of Site four has a reference section. Downstream confluences with larger bodies of water and upstream sections that were intermittent or ephemeral prevented the selection of reference sections at several sites.

Methods

Clinch Ranger District personnel used blue spray paint to delineate the boundaries of the 100-year flood plain along each study section. All downed trees greater than 20 centimeters in diameter that fell within this boundary were counted. Trees were identified by species and placed into one of six categories: 1) *Quercus species* 2) *Acer species* 3) *Betula species* 4) *Liriodendron species* 5) *Magnolia species* and 6) Other, including all trees not identified. Each tree was designated in position as either left, right, or center of channel; facing in an upstream direction. The location of each tree was measured relative to the distance from the downstream end of the

study section. The approximate diameter at breast height (DBH) of each tree was estimated and each tree was placed into a height-above-stream-channel category (0-1 meter, 1-2 meters, 2+ meters above the stream channel).

The wood debris was inventoried by a two person crew. One crew member identified each tree, estimated its diameter, and used a hip chain to measure its distance from the downstream end of the site. Another crew member observed the orientation of the tree and classified its height above the stream channel. Data were summarized using Quattro Pro, SigmaPlot, and SigmaStat.

Results

Unnamed tributary of Chimney Rock Fork (Site One) - Poplars and oaks comprise the majority of trees identified at this site (Table 1, Figure 7). The study section contains 353 pieces of wood per kilometer (569/mile) while the reference section contains only 29 pieces per kilometer (47/mile). The sections combined contain 221 pieces per kilometer (356/mile). Although the diversity of tree species in the reference section is similar to the study section (Figure 7), the study site contains considerably more wood debris than the reference section (Figure 8). The orientation of wood debris in the stream channel favors the center and right bank of the channel (Figure 9). Most of the wood debris is located zero to one meter above the stream channel (Figure 10).

Unnamed tributary of Chimney Rock Fork (Site Two) - This site consists mostly of poplars (Table 2, Figure 11). The study section contains 469 pieces of wood per kilometer (756/mile). The lower reference section contains 58 pieces per kilometer (94/mile) and the upper reference section contains 143 pieces per kilometer (231/mile). All three sections combined contain 339

pieces per kilometer (547/mile). Both the upper and lower reference sections contain similar tree species diversity as the study section (Figure 11). The study section contains considerably more wood debris than either the lower reference section or the upper reference section (Figure 12). The orientation of wood debris in the stream channel favors the center and left bank of the channel (Figure 13). Most of the wood debris is located zero to one meter above the stream channel, with a considerable amount at the one to two meter height as well (Figure 14).

Unnamed tributary of Stony Creek (Site Three A) - Poplars and oaks comprise the majority of trees at this site (Table 3, Figure 15). The study site contains 172 pieces of wood per kilometer (277/mile). Both sections combined contain 104 pieces per kilometer (168/mile). The reference section contains no trees (Figure 16). The orientation of wood debris in the stream channel favored the left bank and center (Figure 17). Most of the wood debris is located zero to one meter above the stream channel (Figure 18).

Unnamed tributary of Stony Creek (Site Three B) - This site consists mostly of poplars (Table 4, Figure 19). The lower reference section is noticeably less diverse and contains far fewer trees than the study section (Figure 19). The study section contains 301 pieces of wood per kilometer (485/mile) and the reference section contains 48 pieces per kilometer (77/mile). Both sections combined contain 225 pieces per kilometer (363/mile). There is more wood debris 35 centimeters and greater in the study section (Figure 20). Wood debris is mostly concentrated in the lower end of the reference section (Figure 20). The orientation of wood debris is mostly concentrated in the center of the channel, but numerous pieces are also present left and right of the channel (Figure 21). This could be due to the steeper banks of the channel. The wood debris is fairly evenly

distributed in height above the stream channel (Figure 22). This factor could be related to the steep banks as well.

Unnamed tributary of Stony Creek (Site Three C) - This site consists mostly of poplars (Table 4, Figure 23). The diversity of tree species and number of trees is much less in the reference section (Figure 23). The study section contains 327 pieces of wood per kilometer (527/mile) and the reference section contains 27 pieces per kilometer (44/mile). Both sections combined contain 214 pieces per kilometer (345/mile). Wood debris is concentrated toward the upper half of the study section (Figure 24). The orientation of wood debris in the stream channel favors the center and left bank of the stream channel (Figure 25). The wood debris is evenly distributed in height throughout the stream channel (Figure 26).

Unnamed tributary of Staunton Creek (Site Four Main Channel) - This site has a fairly even distribution of birch, oak, and poplar (Table 6, Figure 27). The reference section contains equal species diversity, but fewer trees than the study section (Figure 27). The study section contains 368 pieces of wood per kilometer (594/mile) and the reference section contains 54 pieces per kilometer (87/mile). Both sections combined contain 168 pieces per kilometer (271/mile). The estimated diameters of trees in the study section are mostly less than 35 centimeters (Figure 28). The trees in the reference section are concentrated toward the lower end of the section (Figure 28). The orientation of wood debris in the stream channel favors the right bank and left bank over the center of the stream channel (Figure 29). The wood debris is fairly evenly distributed in height above the stream channel (Figure 30).

Unnamed tributary of Staunton Creek (Site Four Left Fork) - This site consists mostly of poplars (Table 7, Figure 31). There is no reference section. The study section contains 159 pieces of wood per kilometer (256/mile). The trees are concentrated toward the lower half of the study site (Figure 32). The orientation of wood debris in the stream channel favors the left bank and center of the channel (Figure 33). The wood debris is fairly evenly distributed in height above the stream channel (Figure 34).

Unnamed tributary of Staunton Creek (Site Four Right Fork) - Oak and Birch made up the majority of trees identified at this site (Table 8, Figure 35). There is no reference section. The study section contains 329 pieces of wood per kilometer (531/mile). The trees estimated in the study section are mostly below 35 centimeters in diameter (Figure 36). The orientation of wood debris in the stream channel favors the center of the channel and right bank (Figure 37). The wood debris is fairly evenly distributed in height above the stream channel (Figure 38).

Discussion

The results of this natural event can be used not only for timber harvest but in another beneficial manner to improve stream habitat at locations within the boundaries of the Clinch Ranger District. Wood debris could be relocated to the reference sections or to stream sections not affected by the event. Because wood debris closer to the stream channel plays a greater role in stream enhancement, the wood debris located in the upper one to two meter height and above two meter height could be placed in the stream channel of the reference sections or other stream sections to improve habitat there. There is enough wood debris in some of the sections to allow timber salvage and relocation of wood debris to other sections or streams. On the other hand, we

do not anticipate any negative effects if nothing is done. All of the reference sites that have little or no wood fall within the current Desired Future Conditions (DFCs) for large woody debris when the study section and reference section or sections are combined. We recommend that the DFC for each stream reach be evaluated using equivalent length of stream in both blow-down and reference sites where possible. Salvage should not remove trees from the blow-down in excess of the amount required to achieve the DFC in the combined (blow-down and reference) reaches.

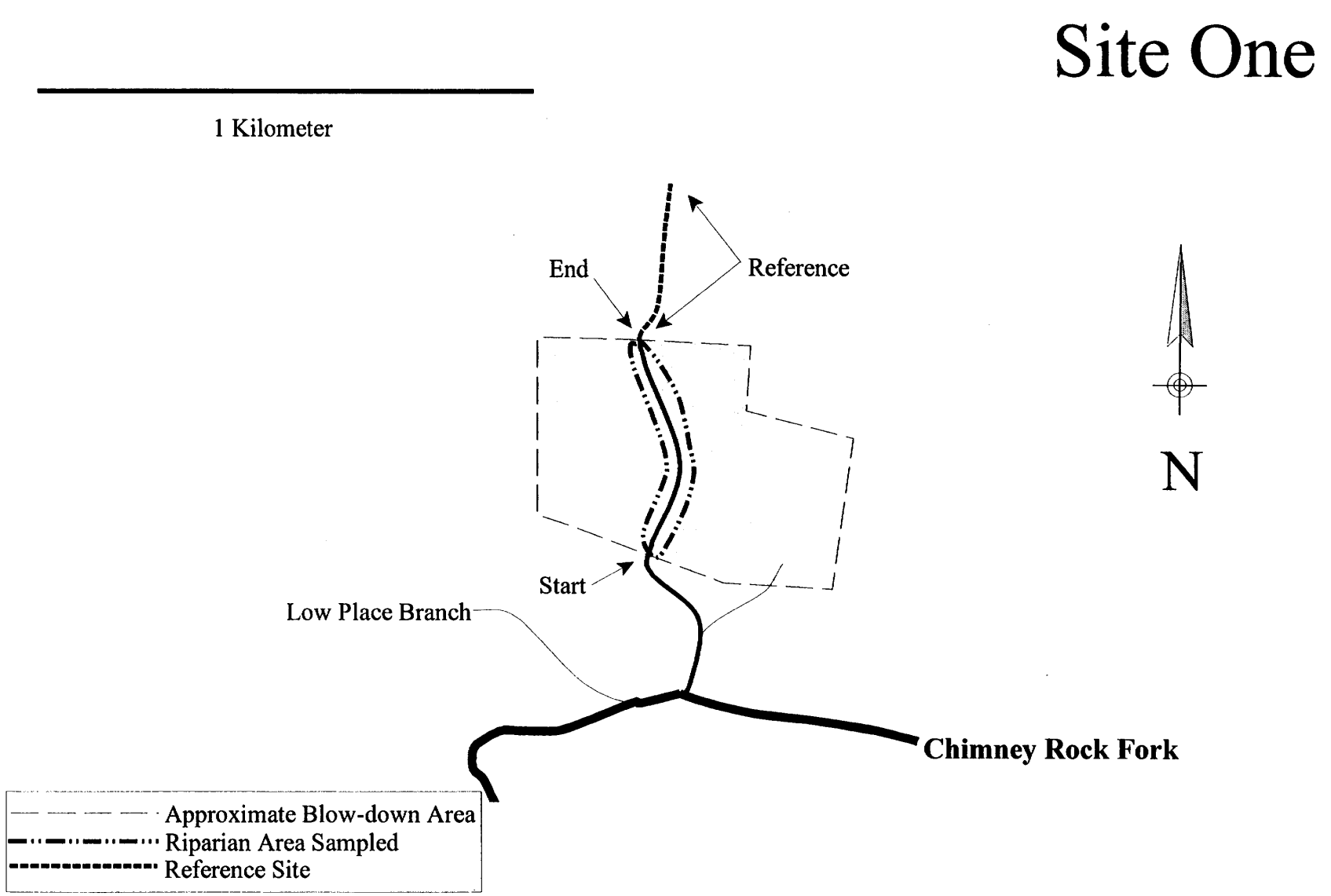

Figure 1. Map of unnamed tributary of Chimney Rock Fork (Site One). Arrows show starting and ending points for study and reference sections. The shaded area shows the approximate location of the blow-down. The reference section is delineated by the broken line outside the blow-down.

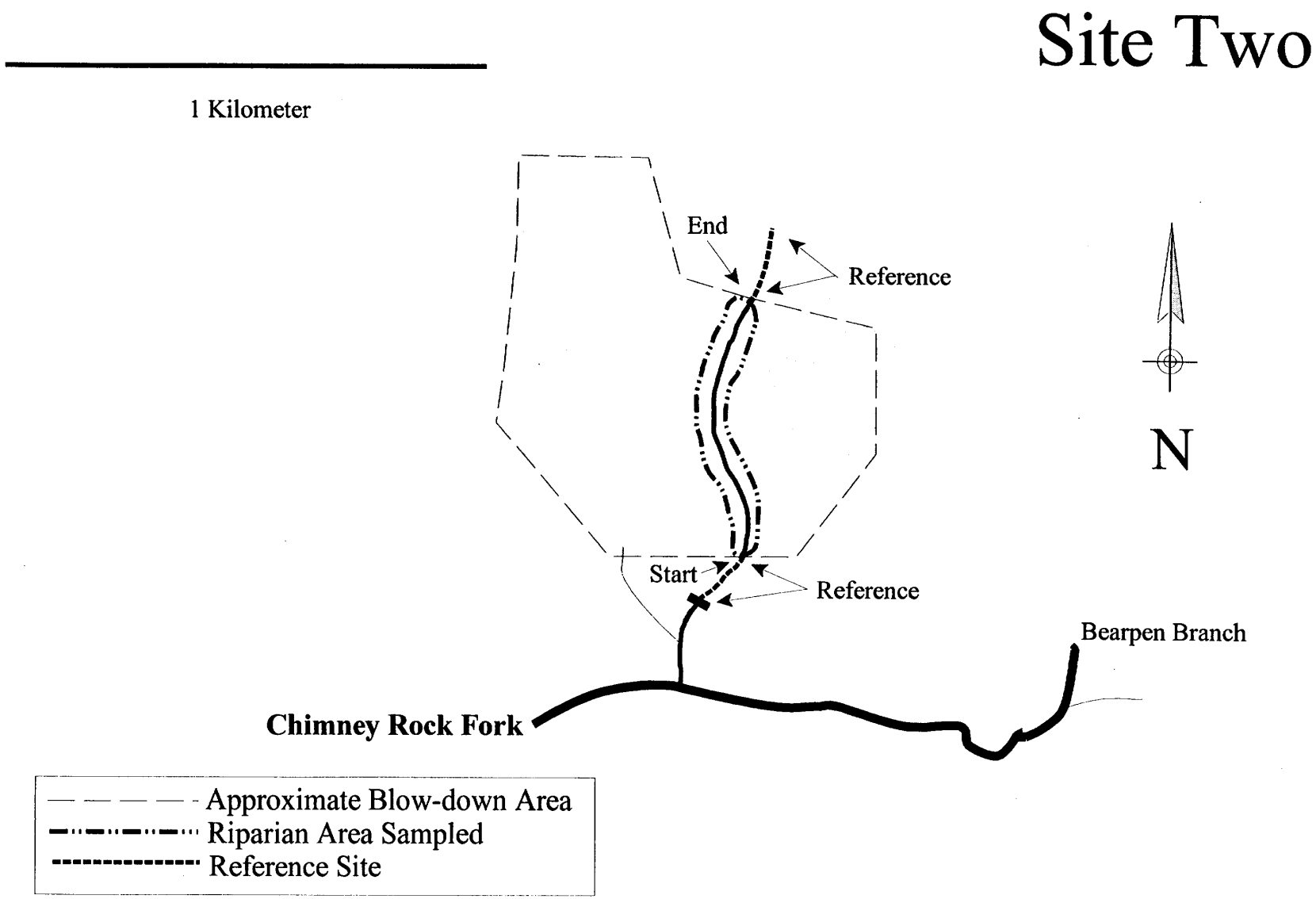

Figure 2. Map of unnnamed tributary of Chimney Rock Fork (Site Two). Arrows show starting and ending points for the study site and both reference sections. The shaded area shows the approximate location of the blow-down. The broken lines above and below the shaded area delineate the reference sections.

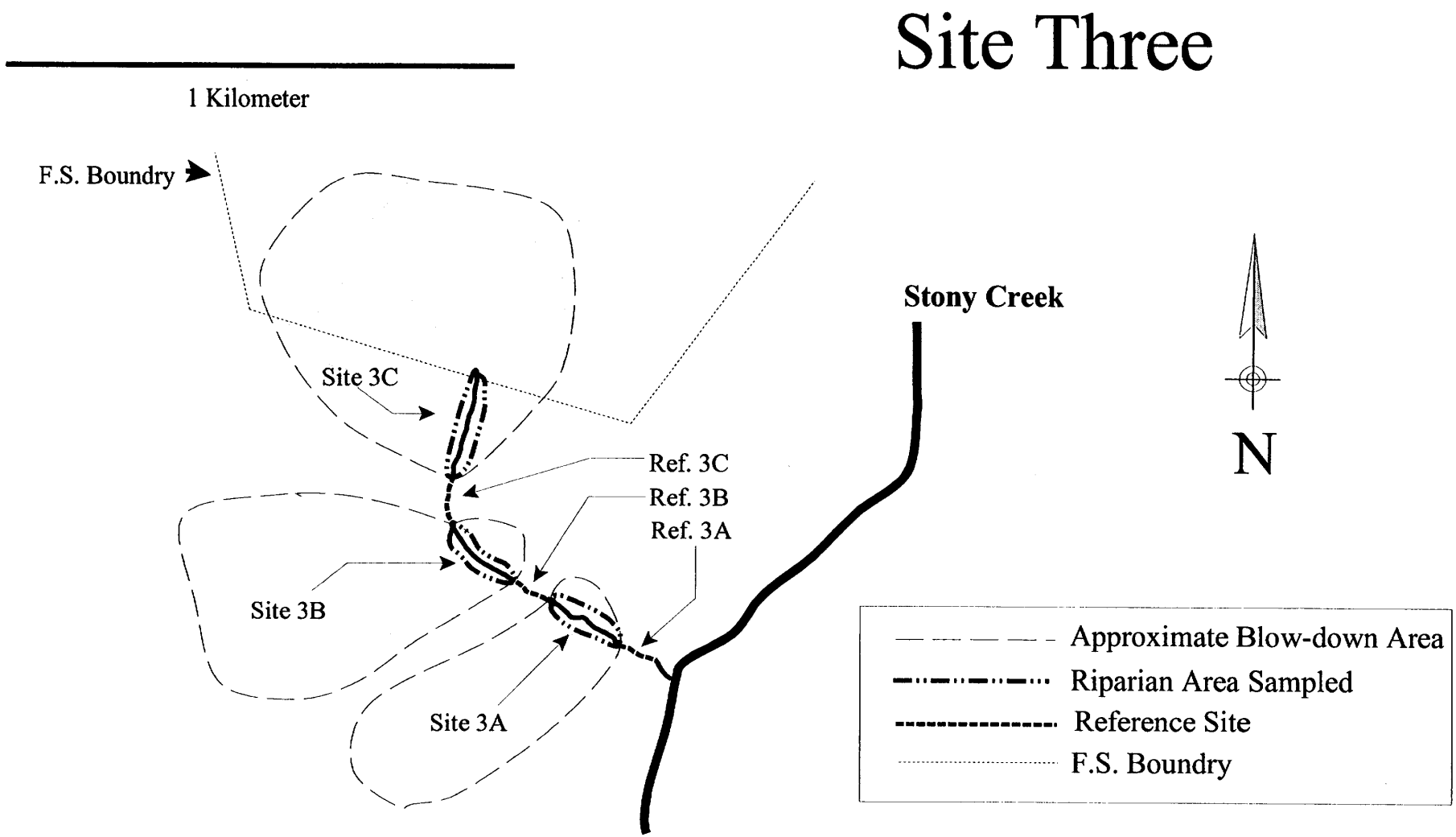

Figure 3. Map of unnamed tributary of Stony Creek (Sites Three A, B, C). The shaded areas show the approximate location of the blow-downs. The solid lines within the blow-down areas are the three study sites and the dashed lines in between the blow-downs represent the three reference sections.

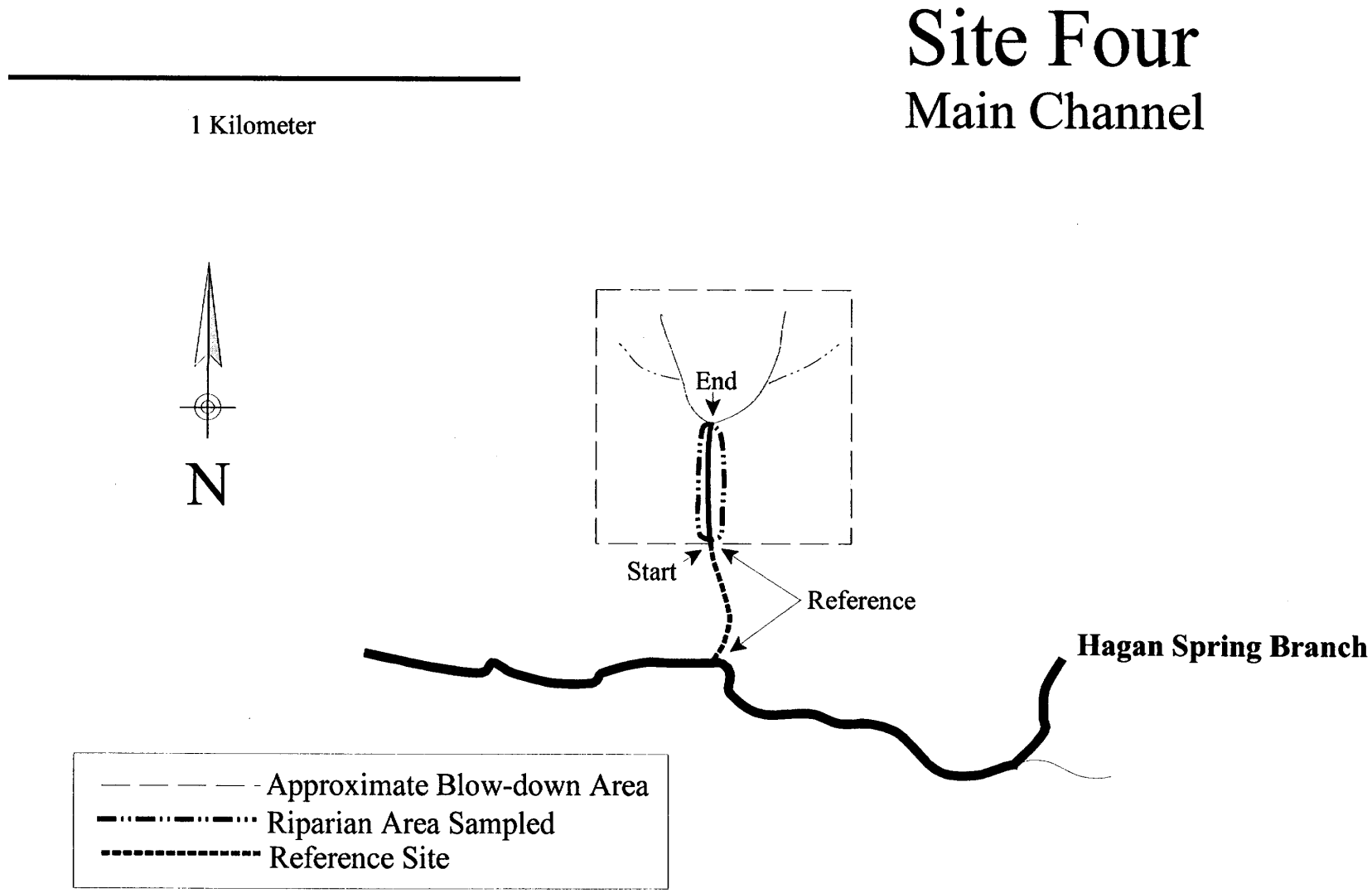

Figure 4. Map showing main channel of unnamed tributary of Hagan Spring Branch (Site Four main channel). Arrows show starting and ending points for the study and reference sections. The shaded area shows the approximate location of the blow-down. The reference section is shown by the broken line beginning at the confluence with Hagan Spring Branch and ending at the starting point for the study area.

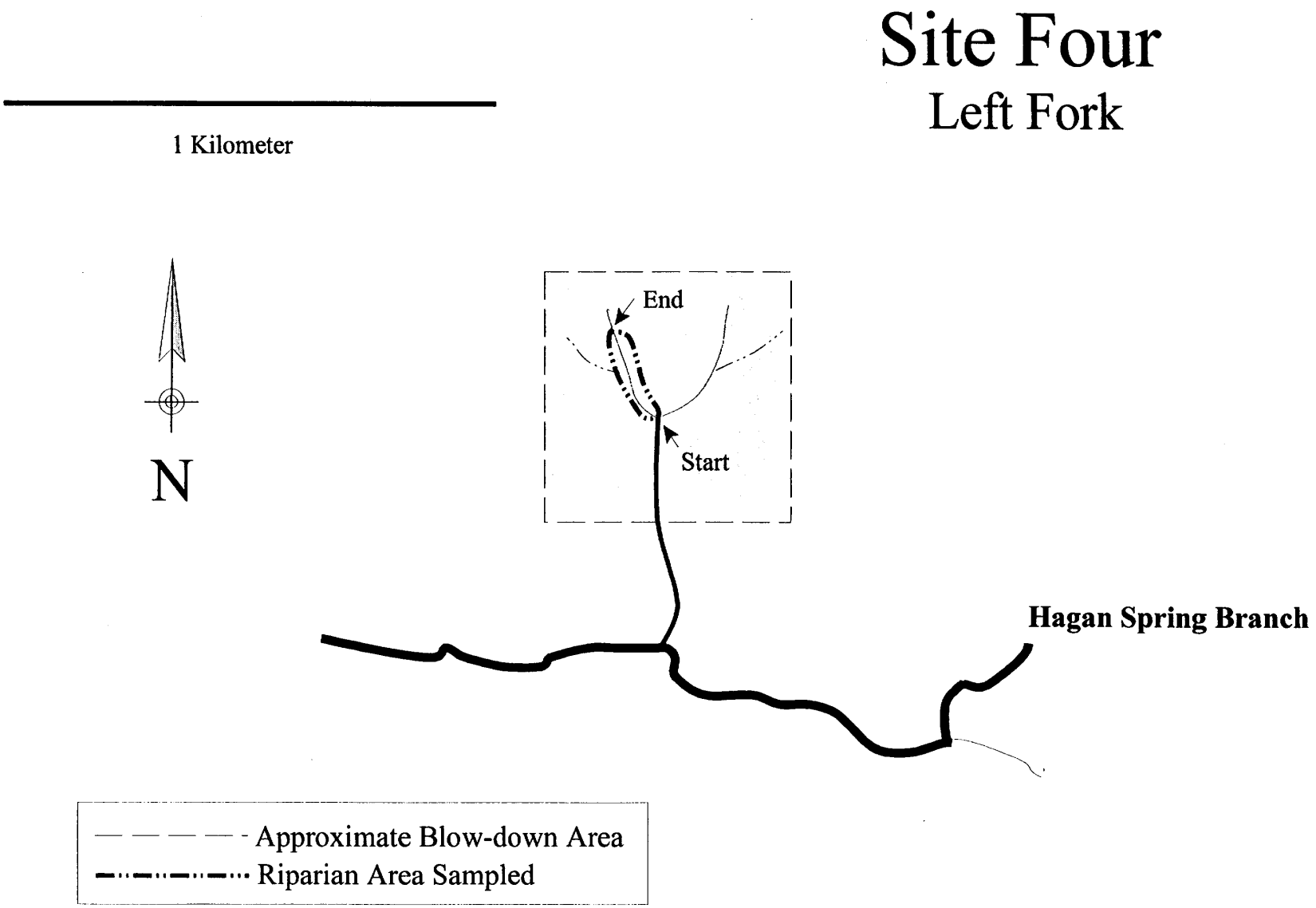

Figure 5. Map showing left fork of unnnamed tributary of Hagan Spring Branch (Site Four left fork). Arrows show starting and ending points for the study section. The shaded area shows the approximate location of the blow-down.

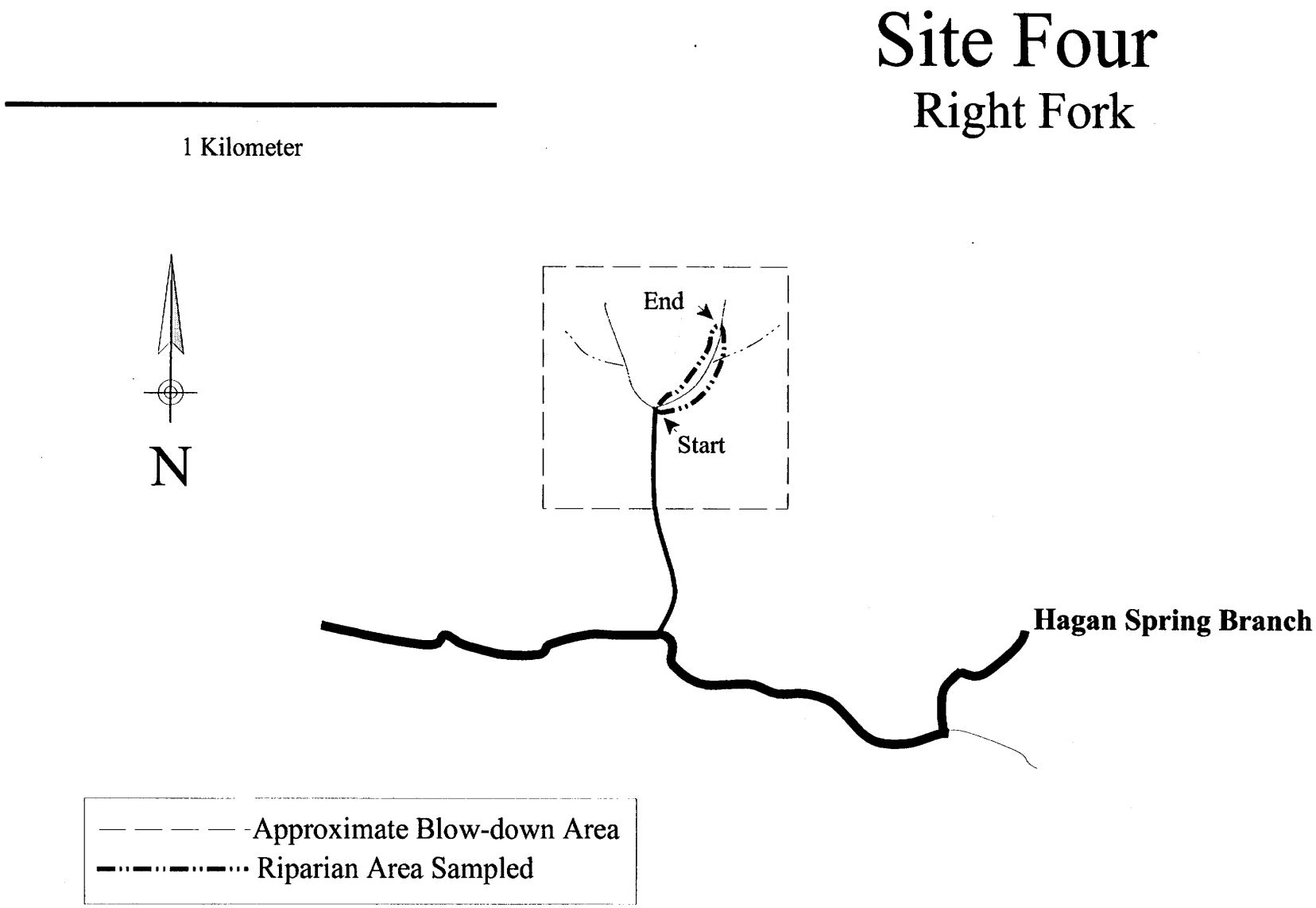

Figure 6. Map showing right fork of unnamed tributary of Hagan Spring Branch (Site Four right fork). Arrows show starting and ending points for the study section. The shaded area shows the approximate location of the blow-down.

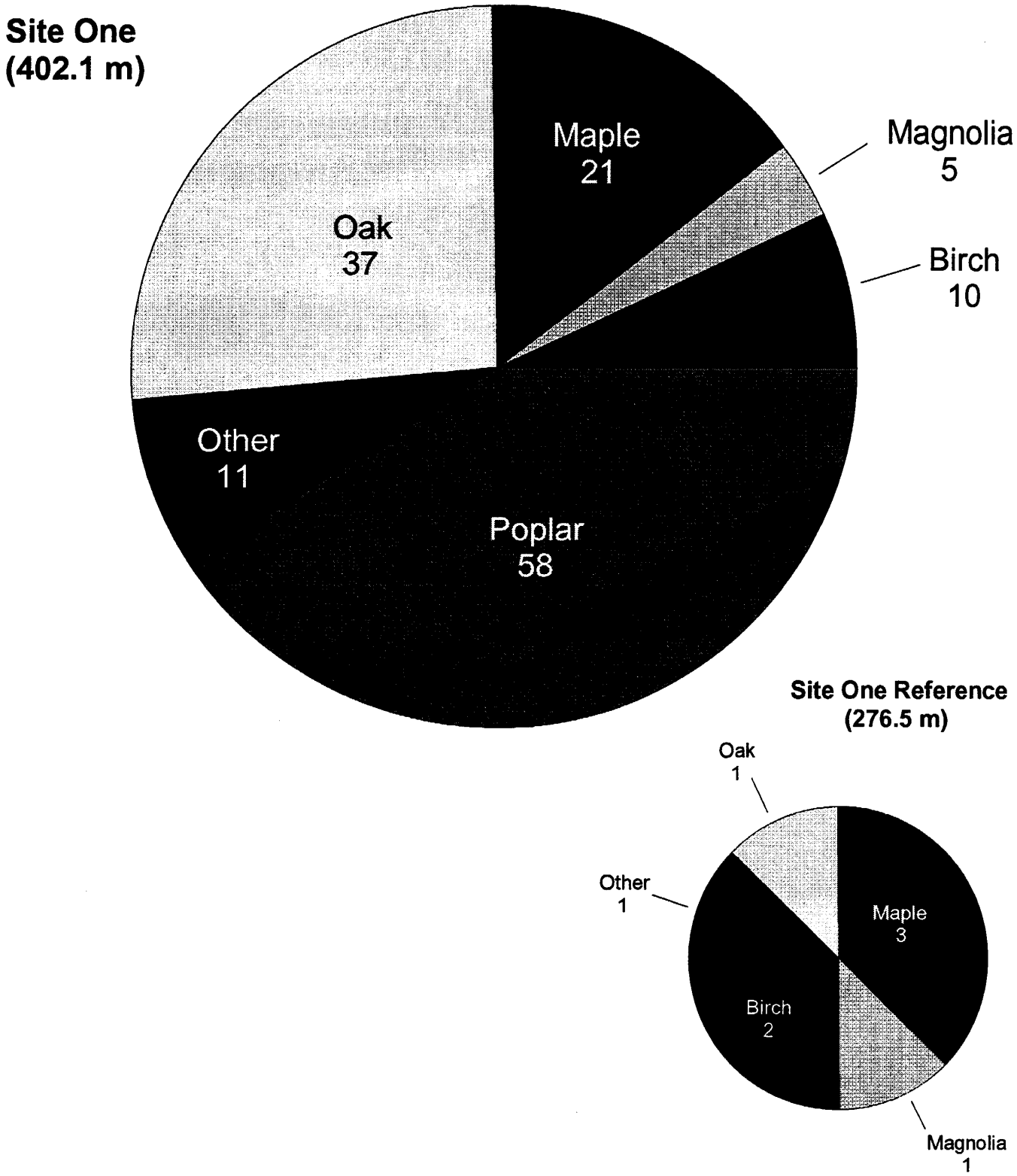

Figure 7. Species distribution of trees in site one and site one reference.

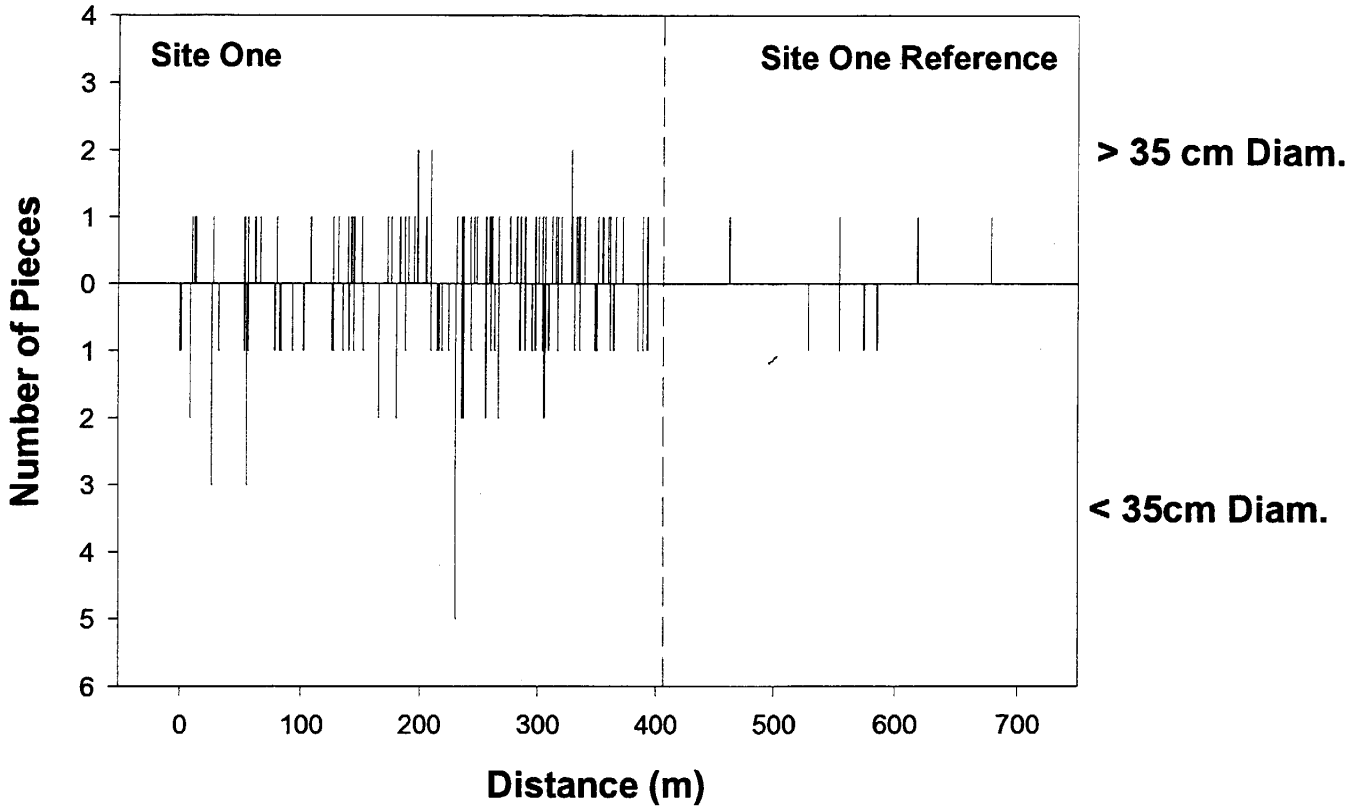

Figure 8. Distribution and number of trees in site one and site one reference. Dotted vertical line represents delineation between site and reference section.

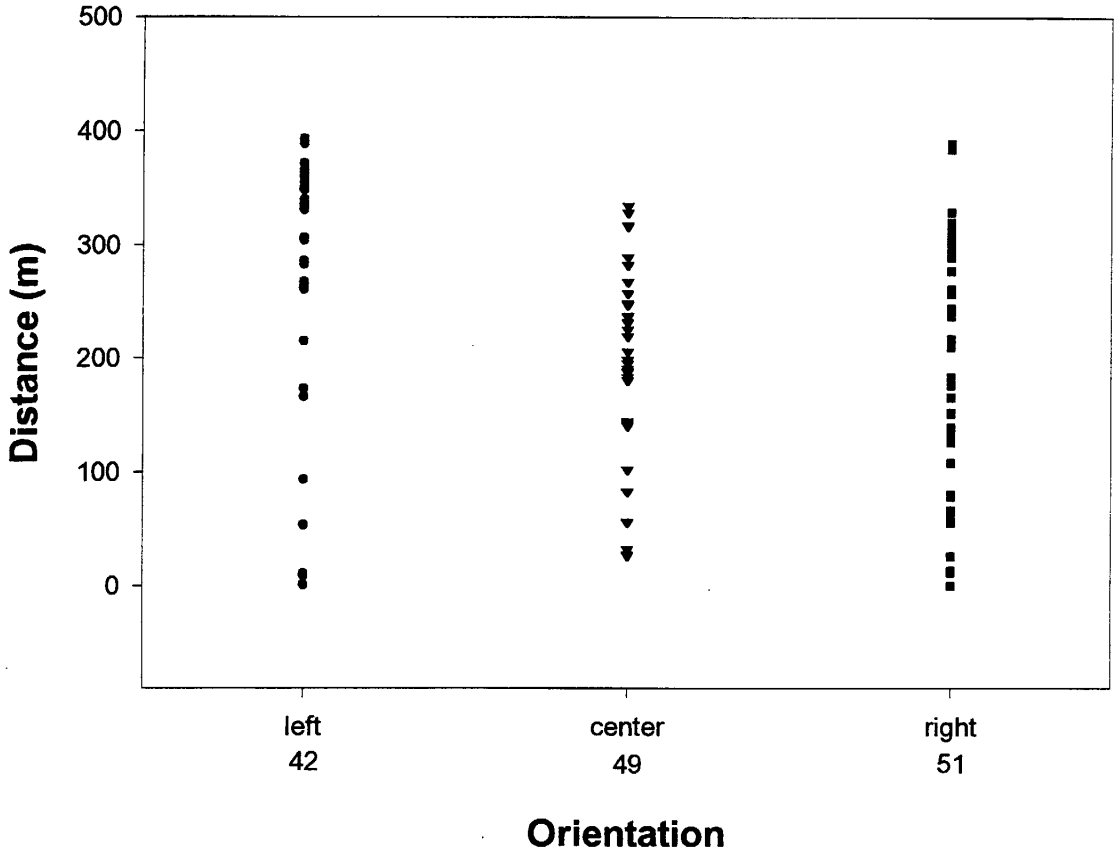

Figure 9. Orientation of trees at site one in relation to the stream channel. Numbers below orientation represent number of trees found in these areas.

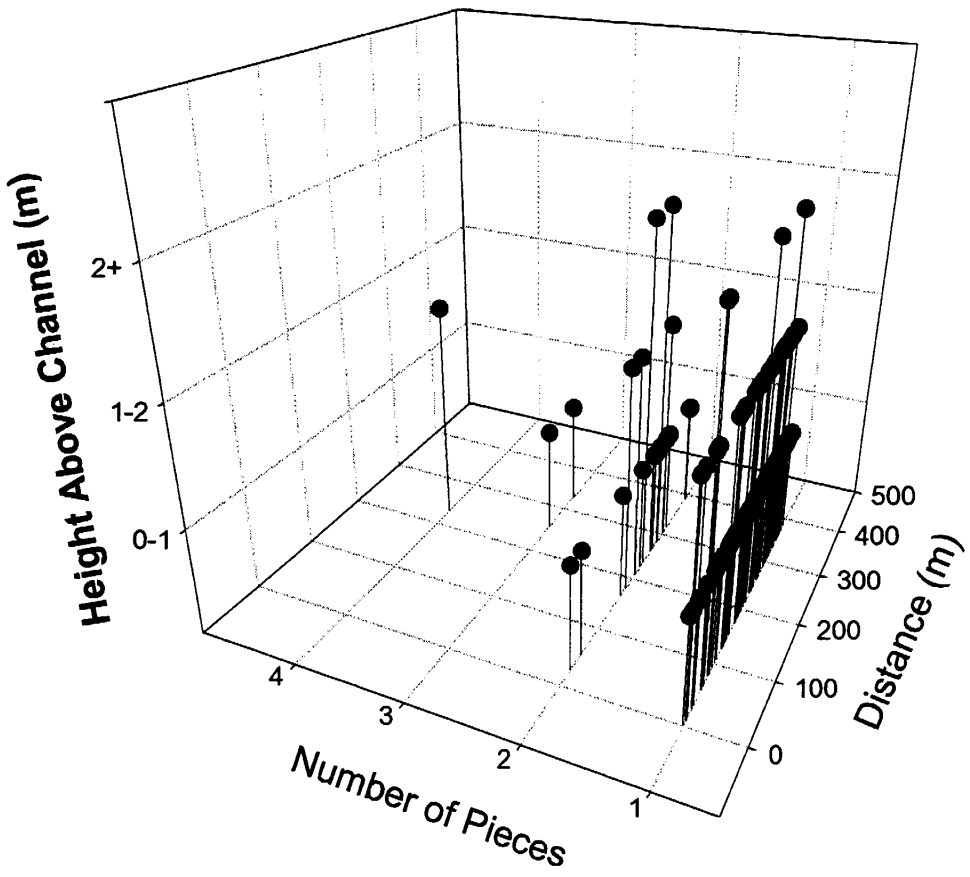

Figure 10. Height above stream channel for each tree in site one.

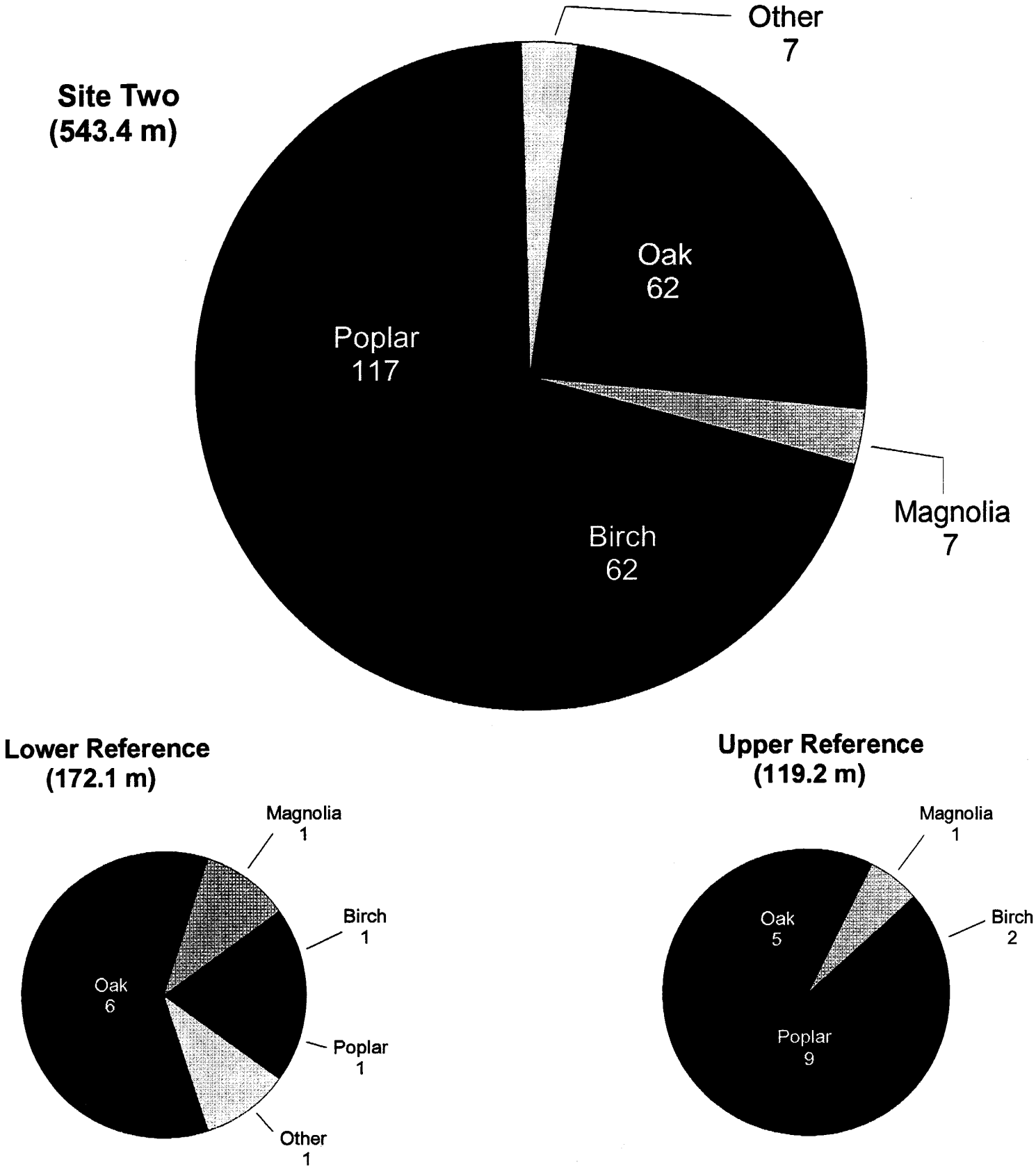

Figure 11. Species distribution of trees in site two, site two upper reference, and site two lower reference.

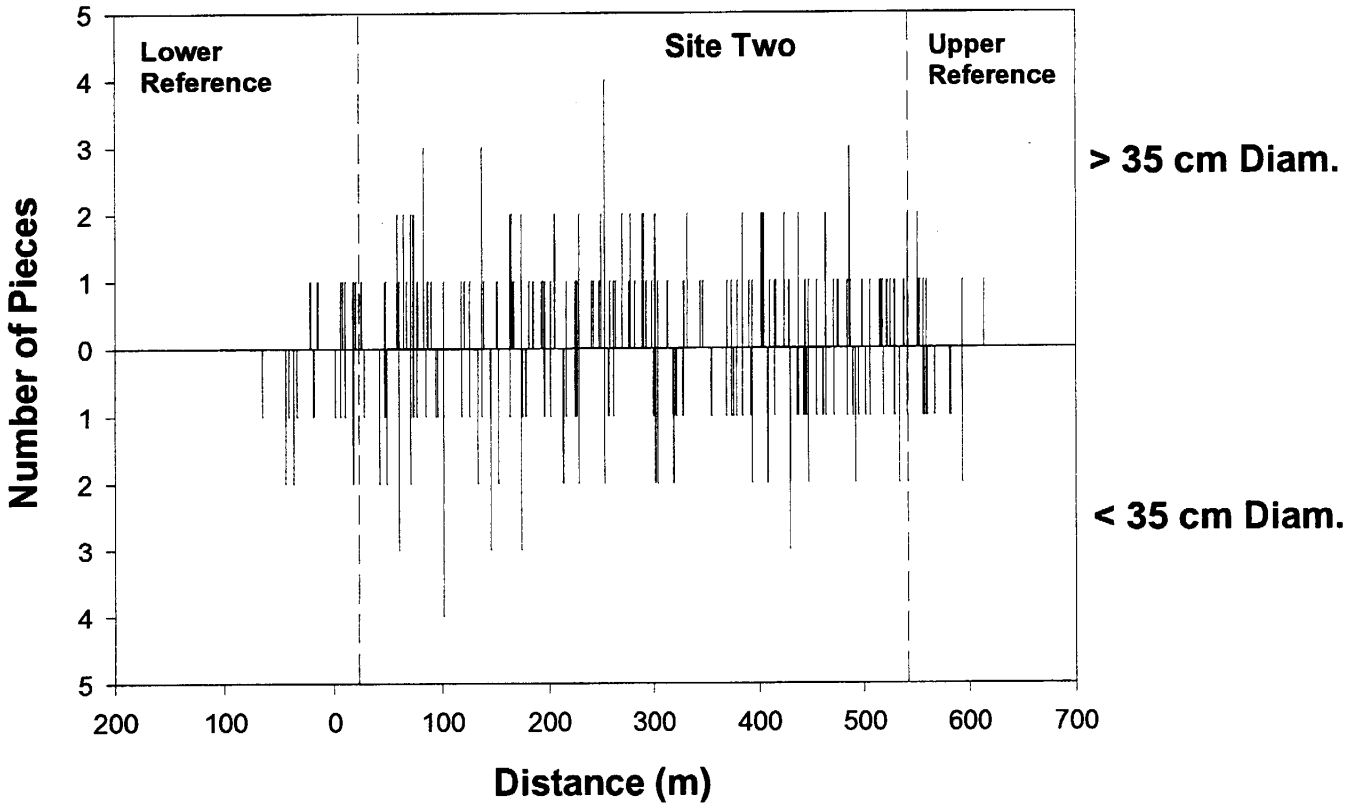

Figure 12. Distribution and number of trees in site two, site two upper reference, and site two lower reference. Dotted vertical line represents delineation between site and reference sections.

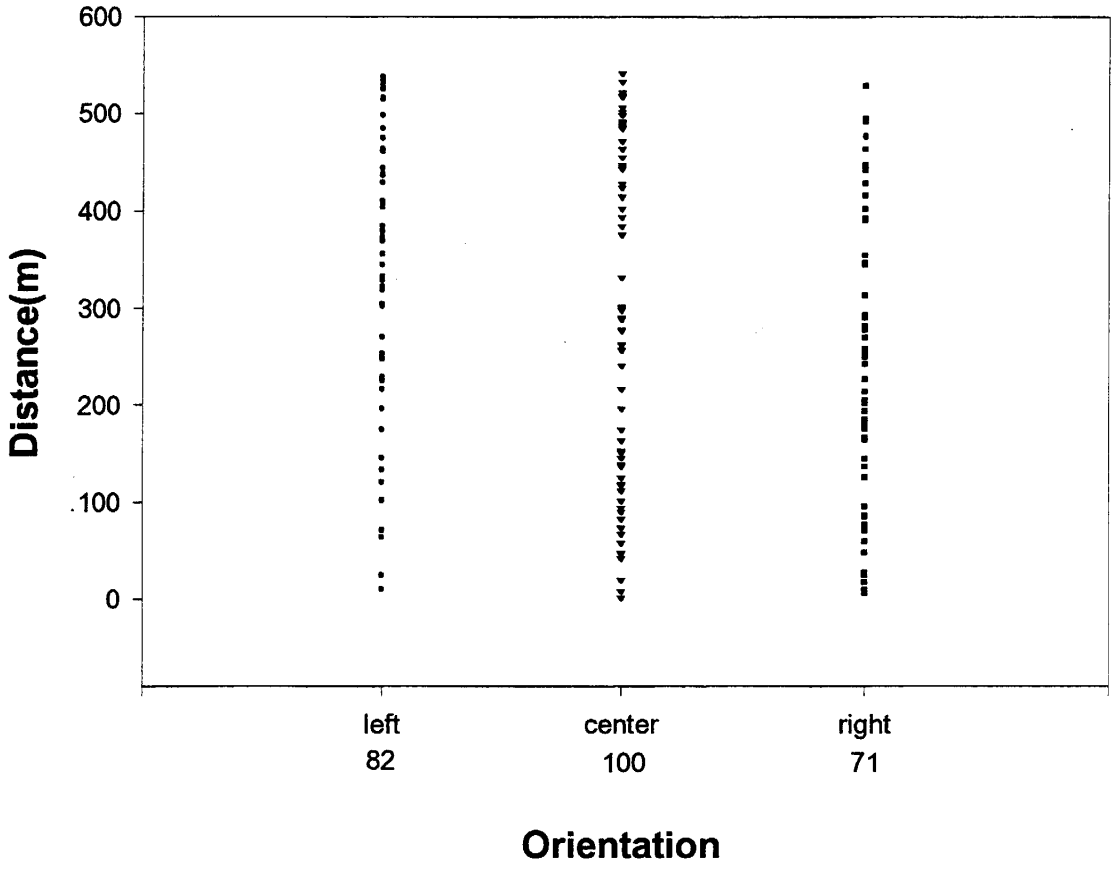

Figure 13. Orientation of trees at site two in relation to the stream channel. Numbers below orientation represent number of trees found in these areas.

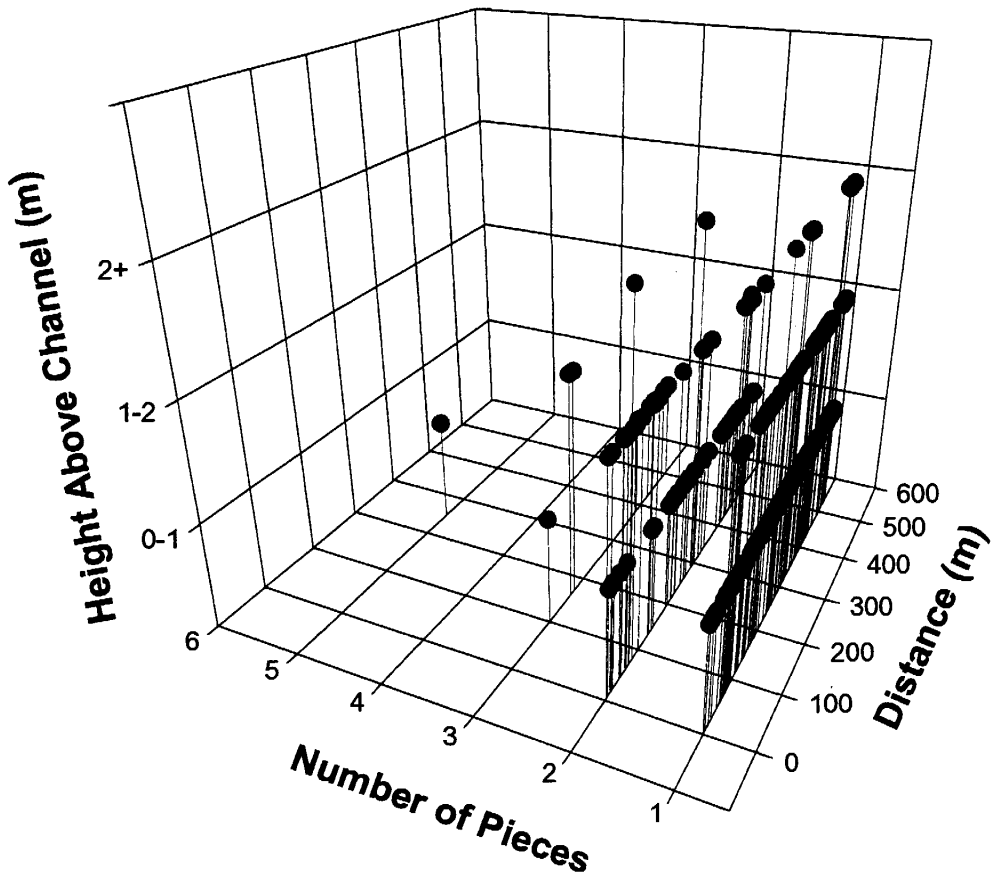

Figure 14. Height above stream channel for each tree in site two.

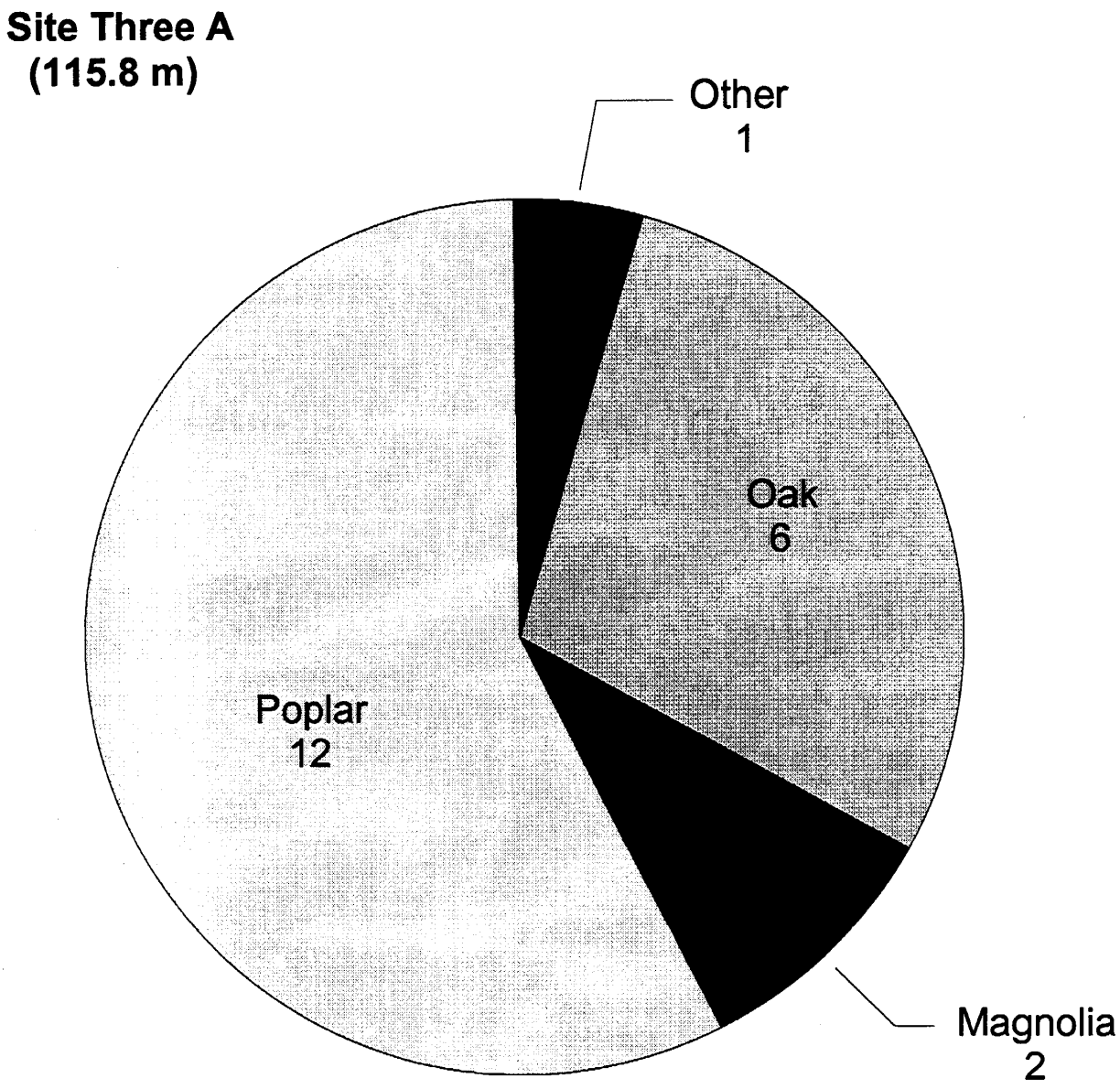

Figure 15. Species distribution of trees in site three A. The reference for site three A contained no trees.

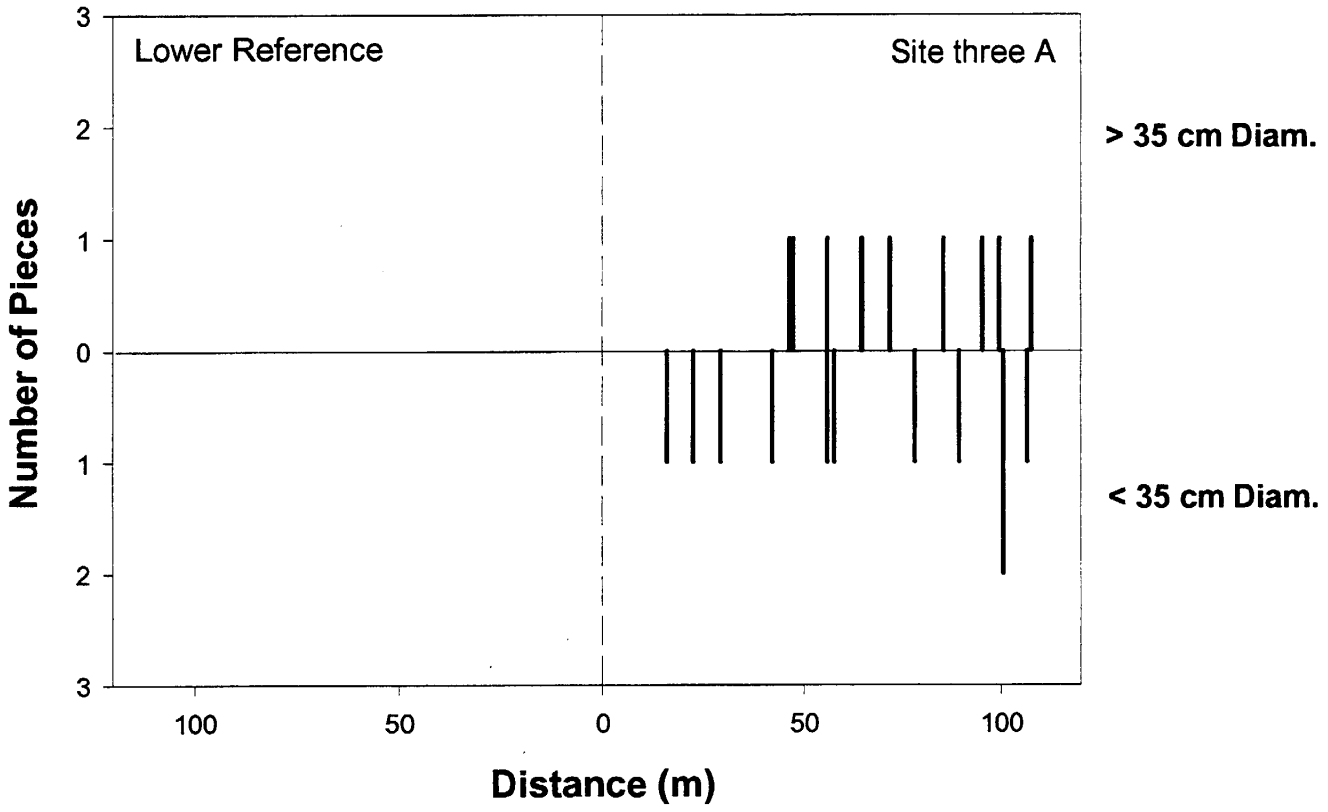

Figure 16. Distribution and number of trees in site three A and site three A reference. The reference section contained no trees. Dotted vertical line represents delineation between site three A and the reference section.

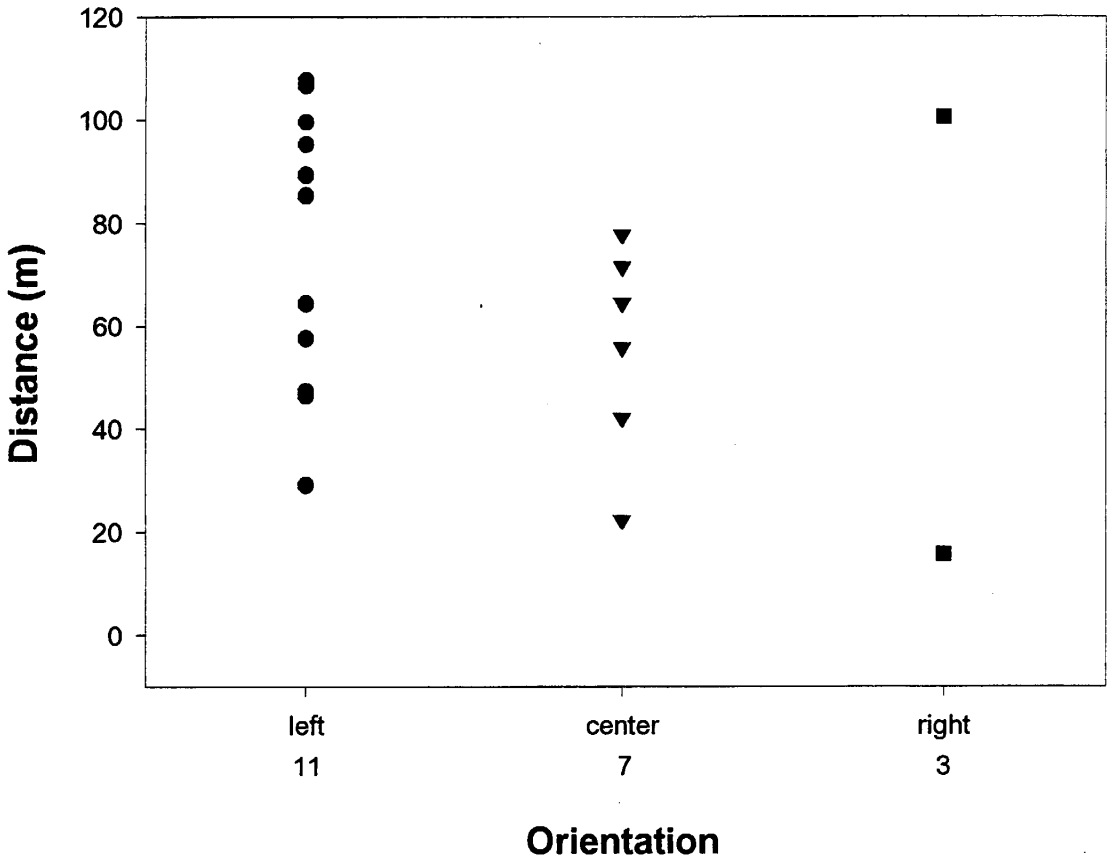

Figure 17. Orientation of trees at site three A in relation to the stream channel. Numbers below orientation represent number of trees found in these areas.

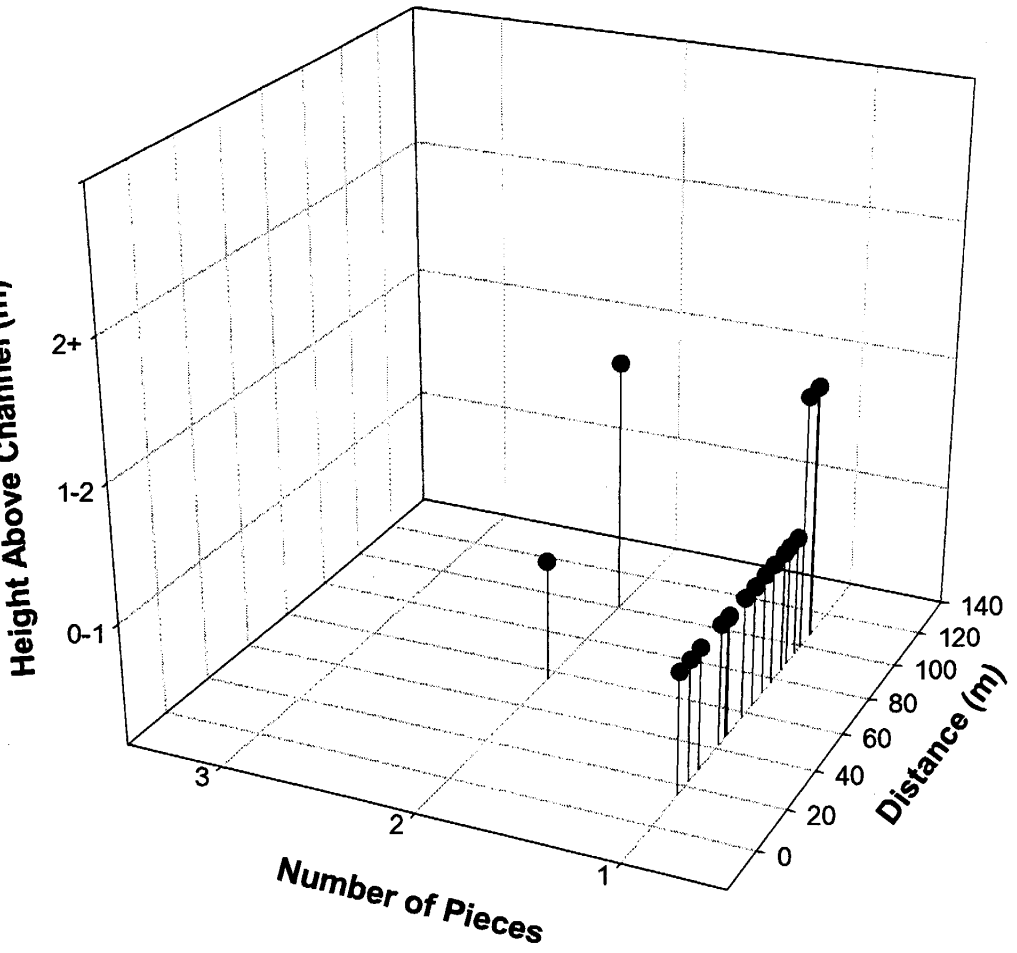

Figure 18. Height above stream channel for each tree in site three A.

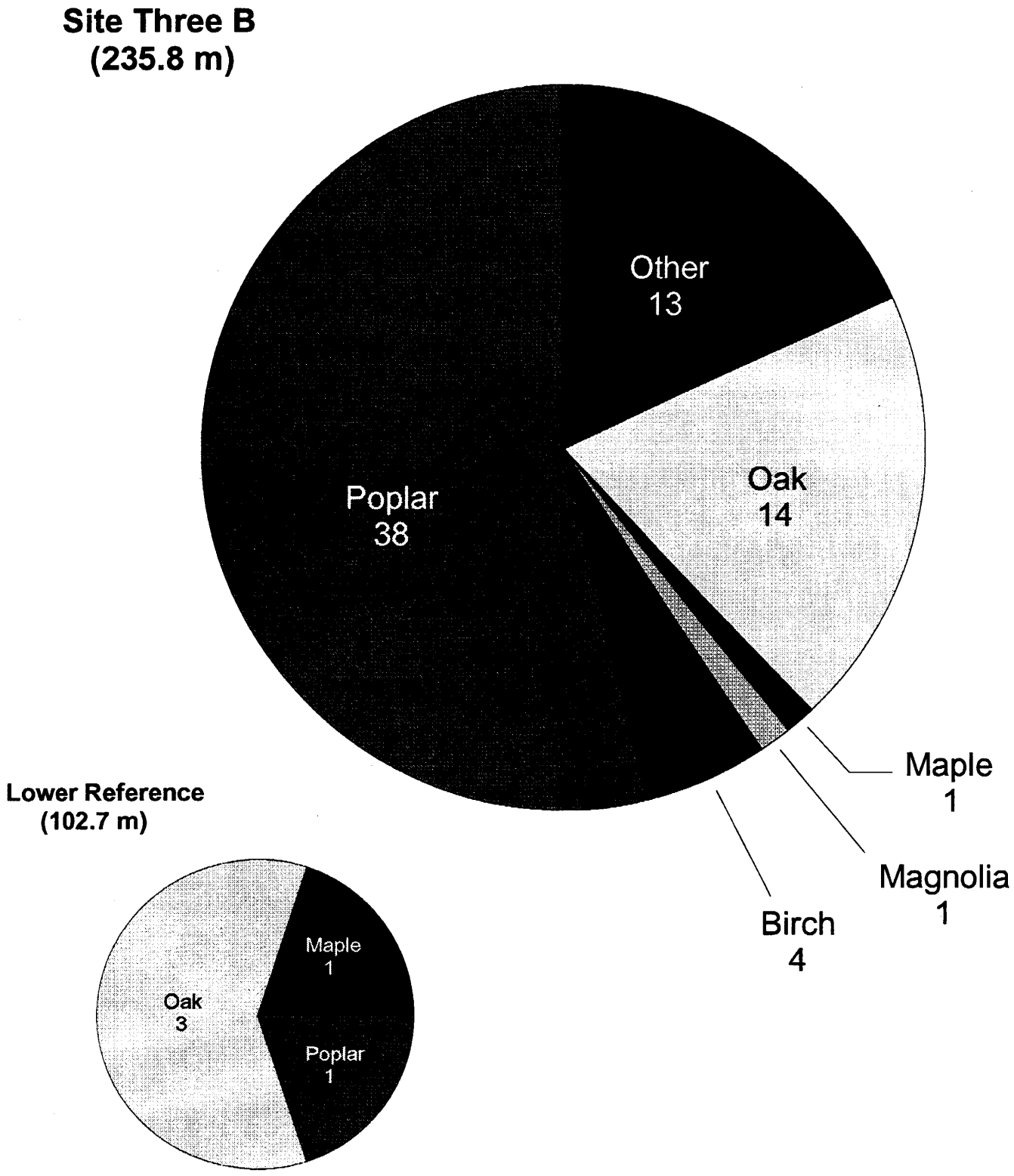

Figure 19. Species distribution of trees in site three B and site three B lower reference.

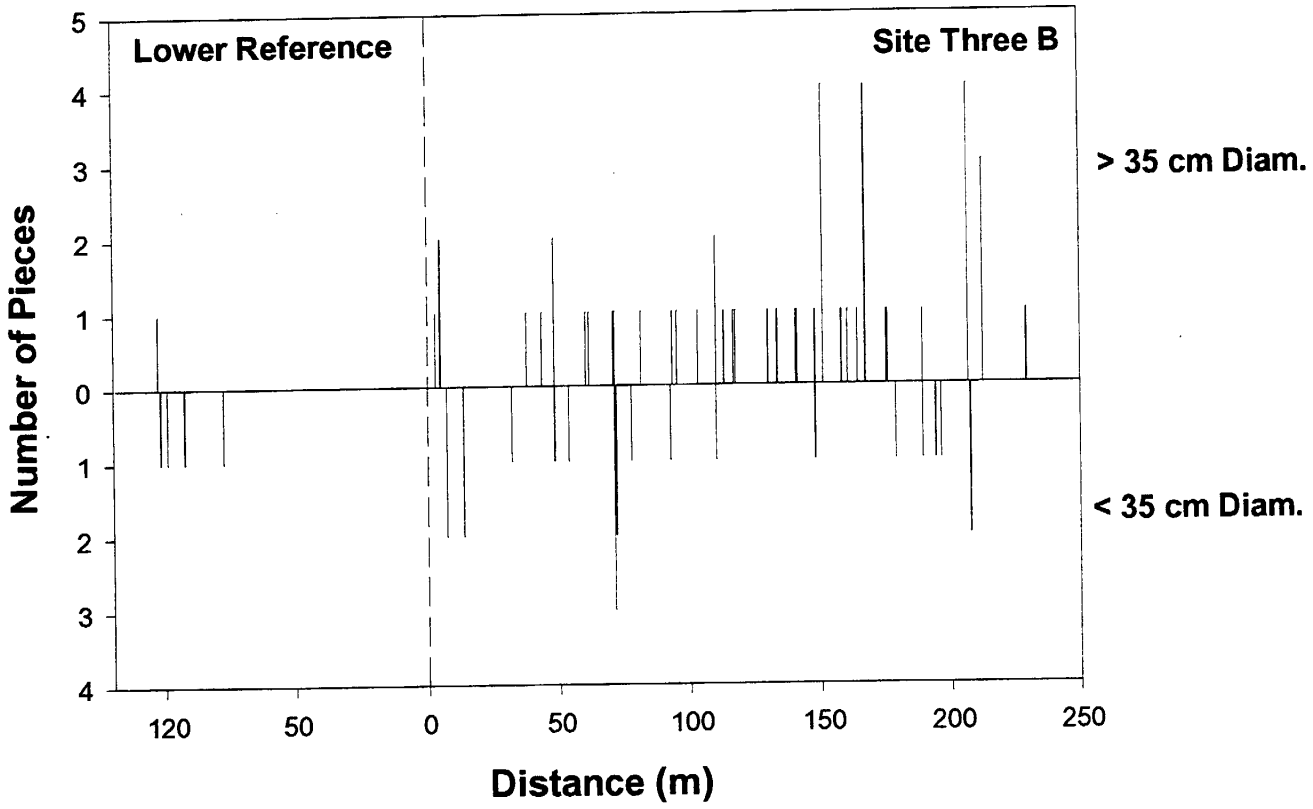

Figure 20. Distribution and number of trees in site three B and site three B lower reference. Dotted vertical line represents delineation between site and reference section.

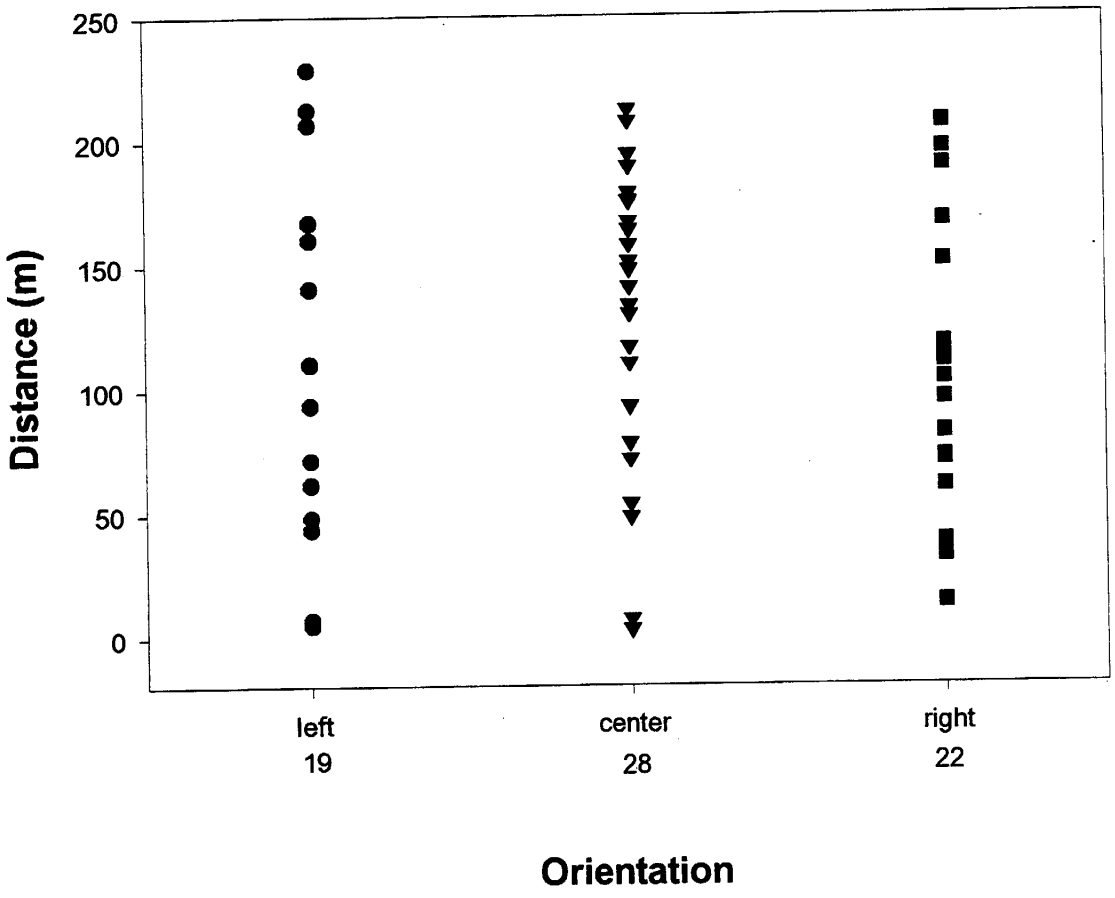

Figure 21. Orientation of trees in relation to the stream channel from a facing upstream perspective.

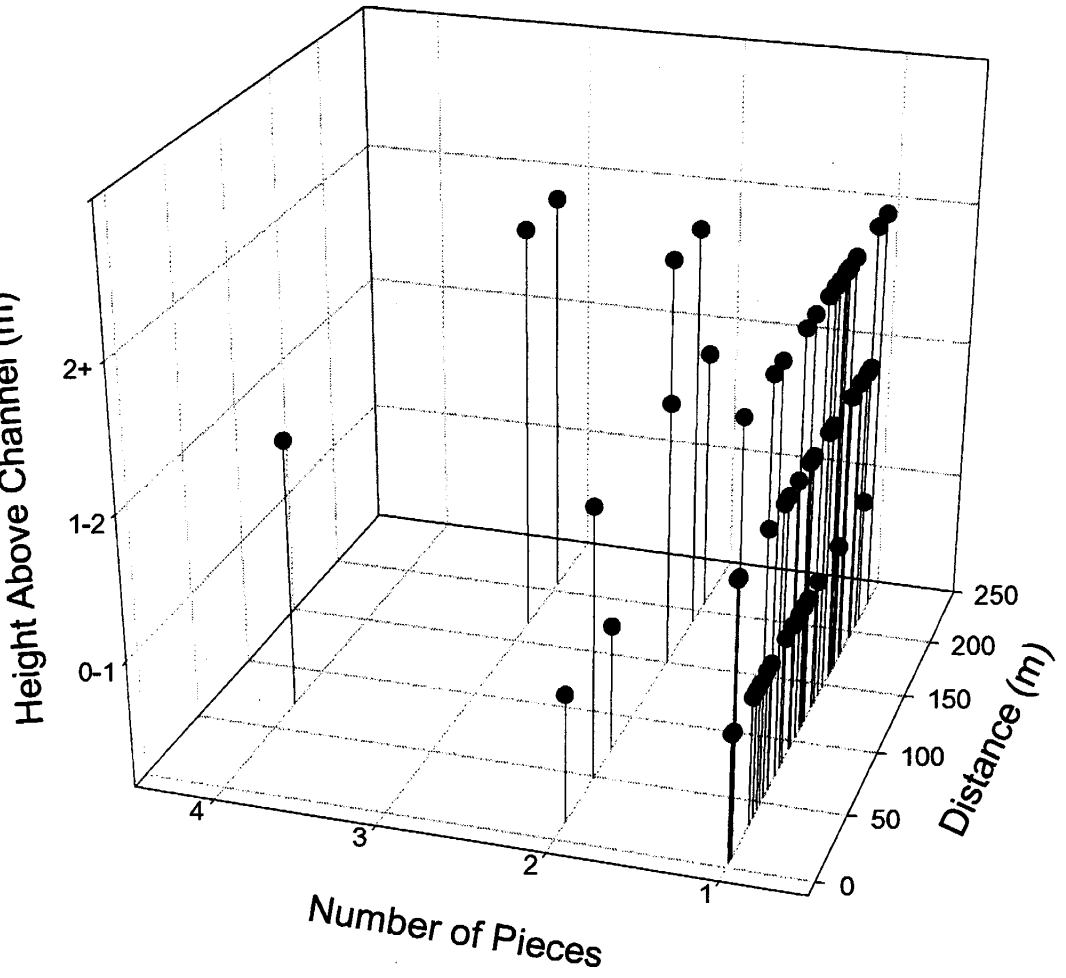

Figure 22. Height above stream channel for each tree in site three B.

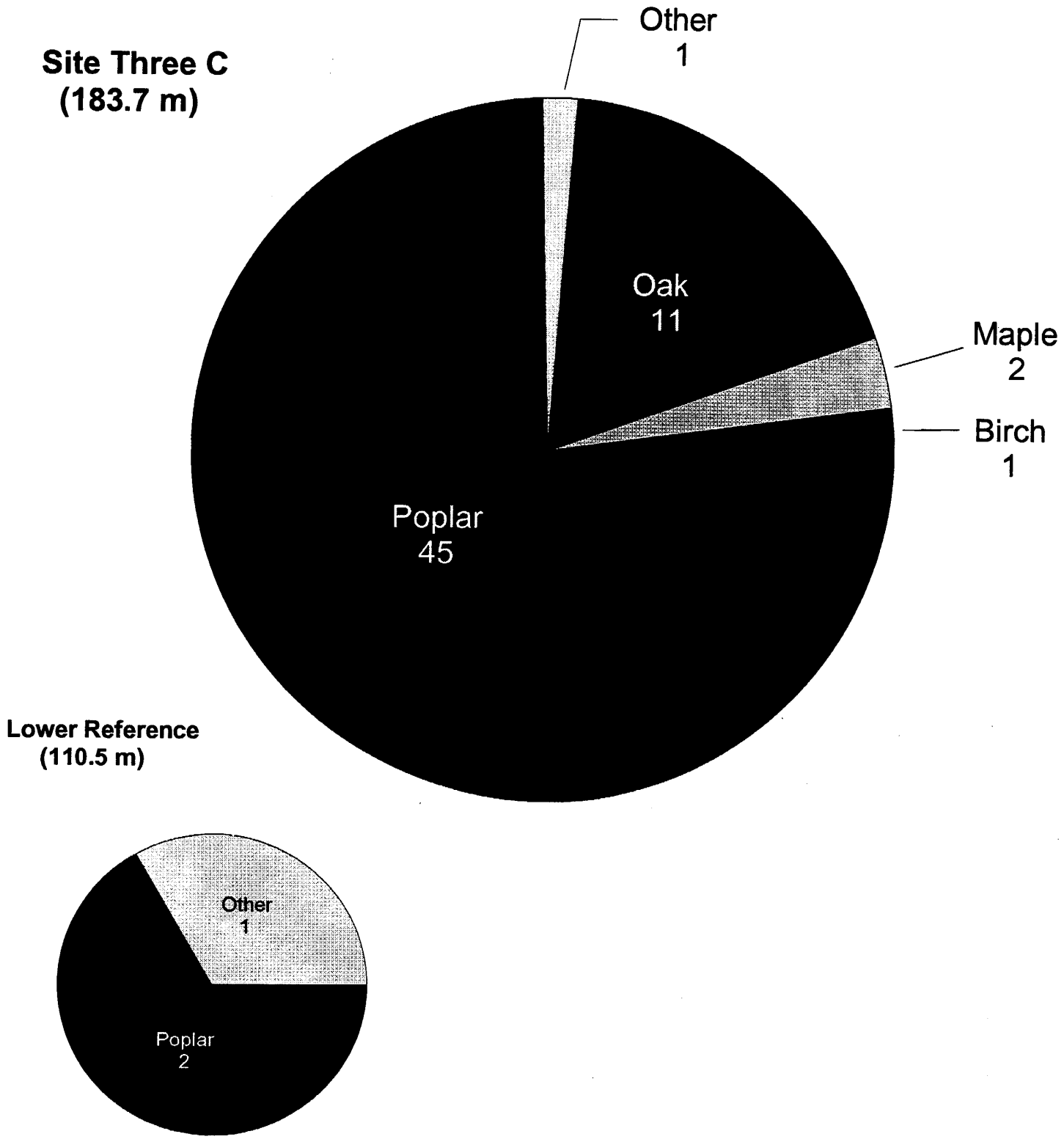

Figure 23. Species distribution of trees in site three C and site three C lower reference.

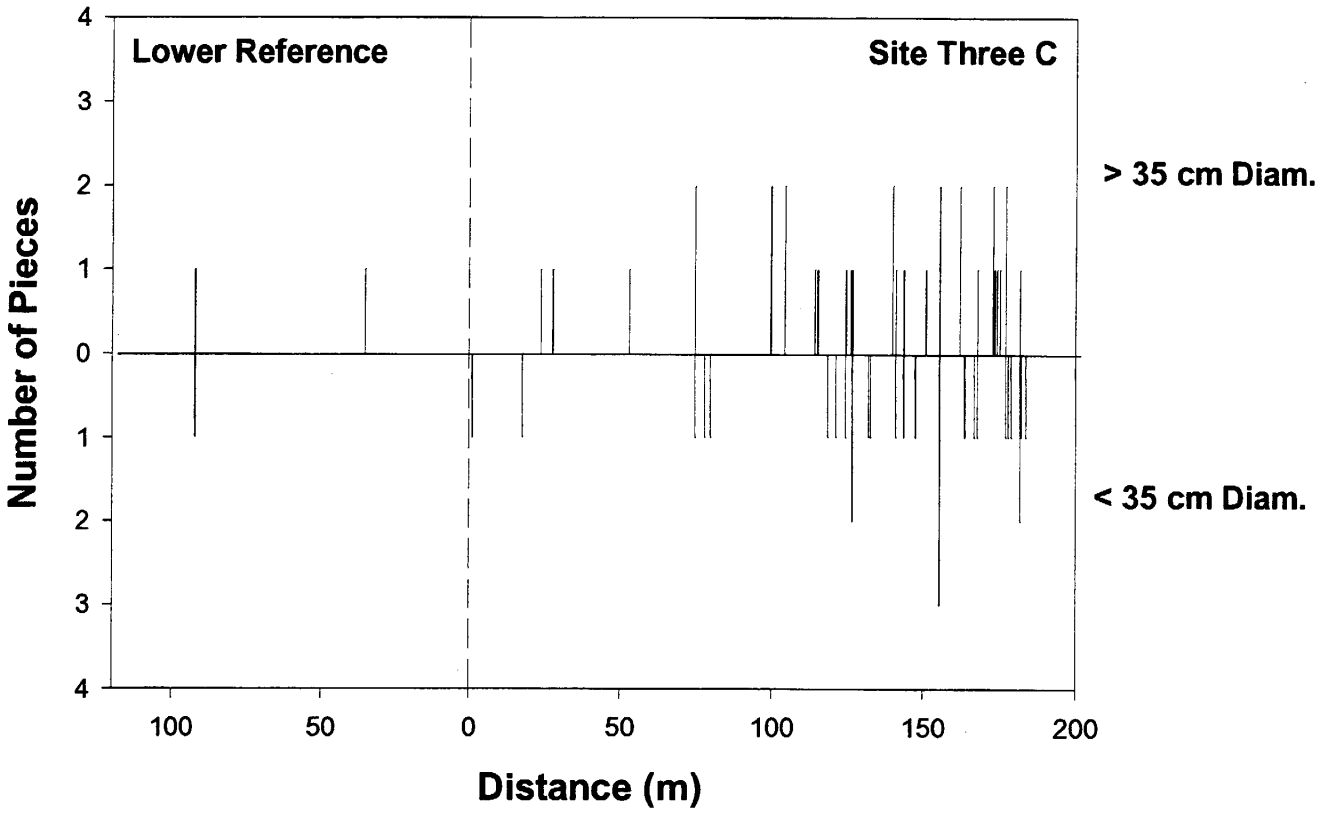

Figure 24. Distribution and number of trees in site three C and site three C lower reference. Dotted vertical line represents delineation between site and reference section.

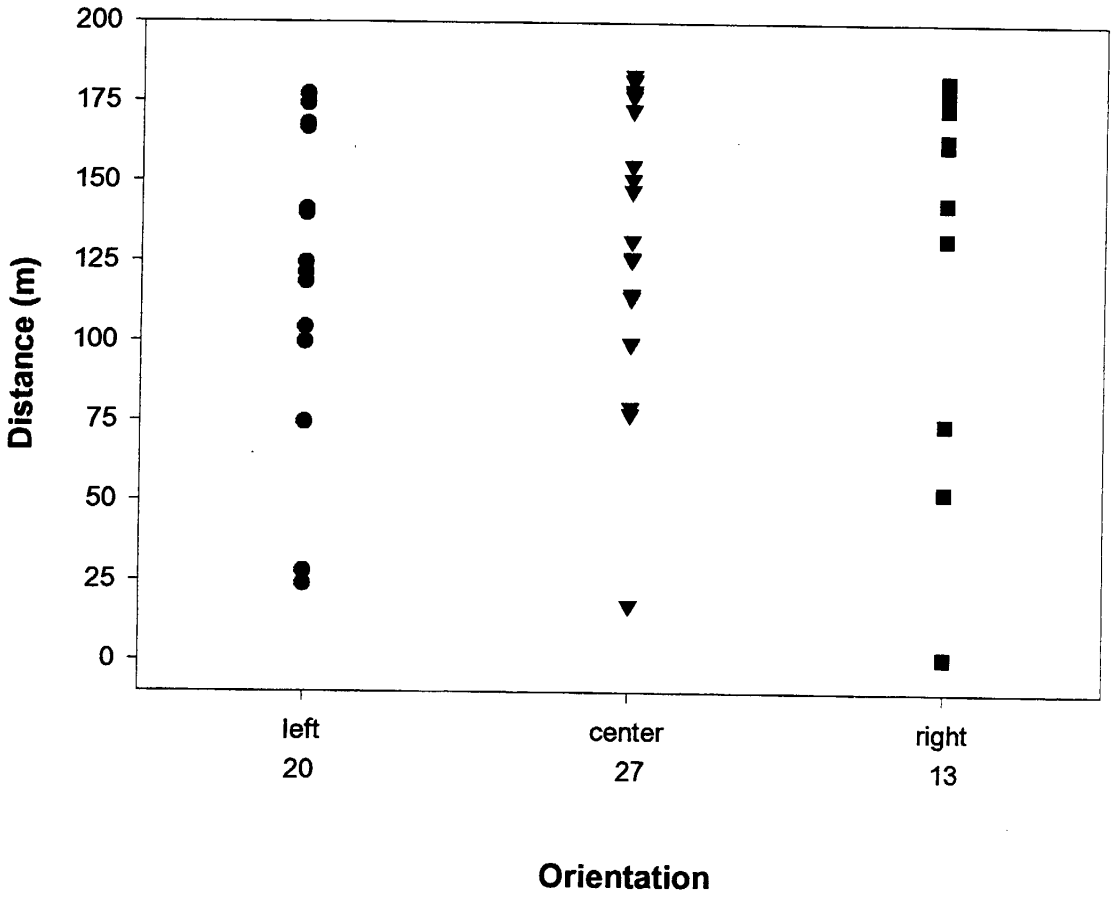

Figure 25. Orientation of trees at site three C in relation to the stream channel. Numbers below orientation represent number of trees found in these areas.

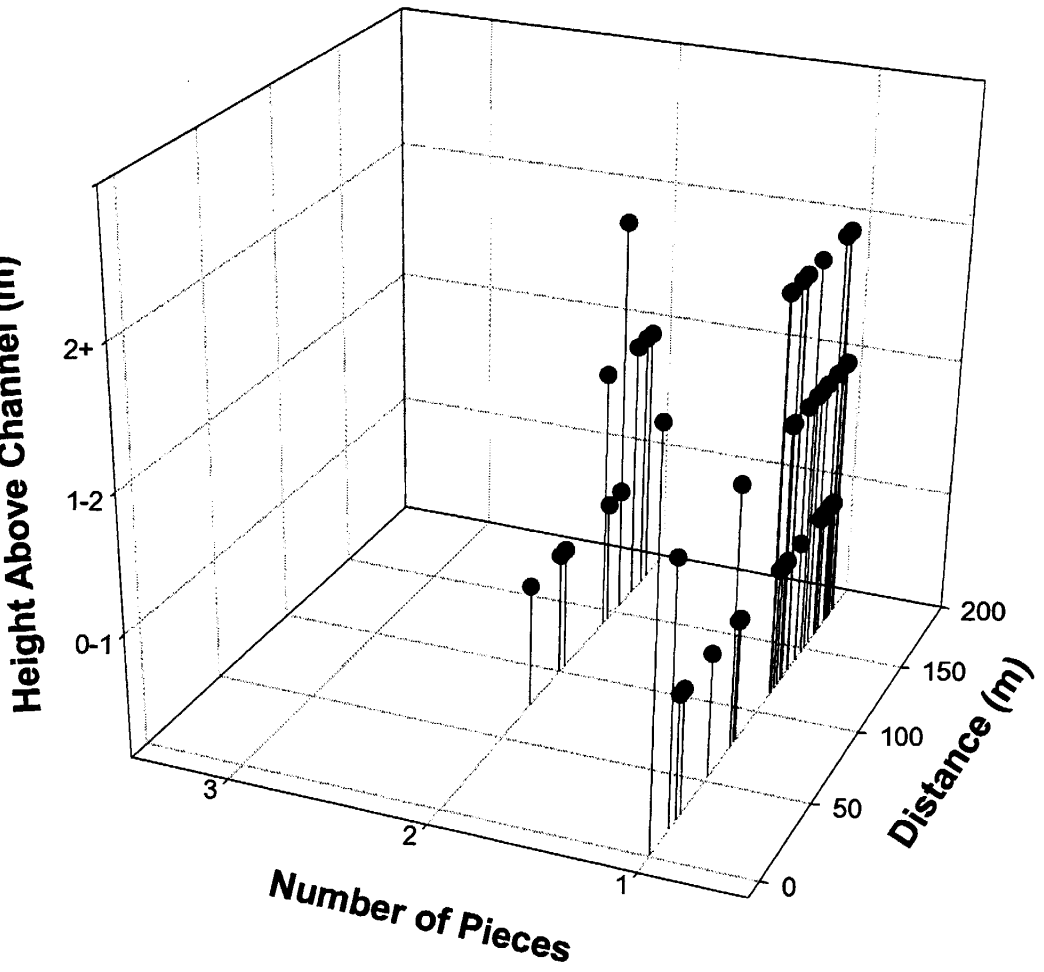

Figure 26. Height above stream channel for each tree in site three C.

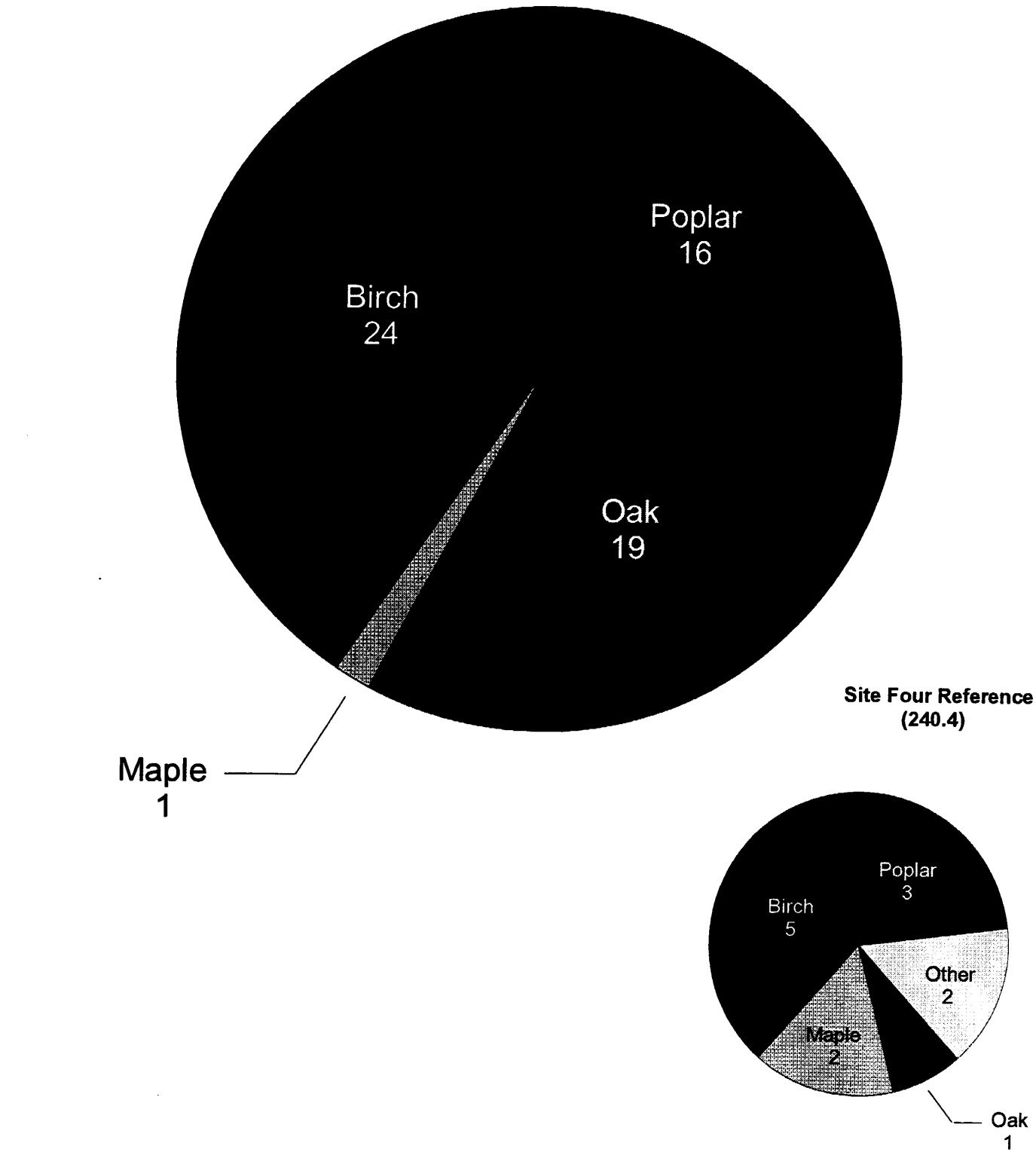

Figure 27. Species distribution of trees in site four (main channel) and site four reference (below main channel).

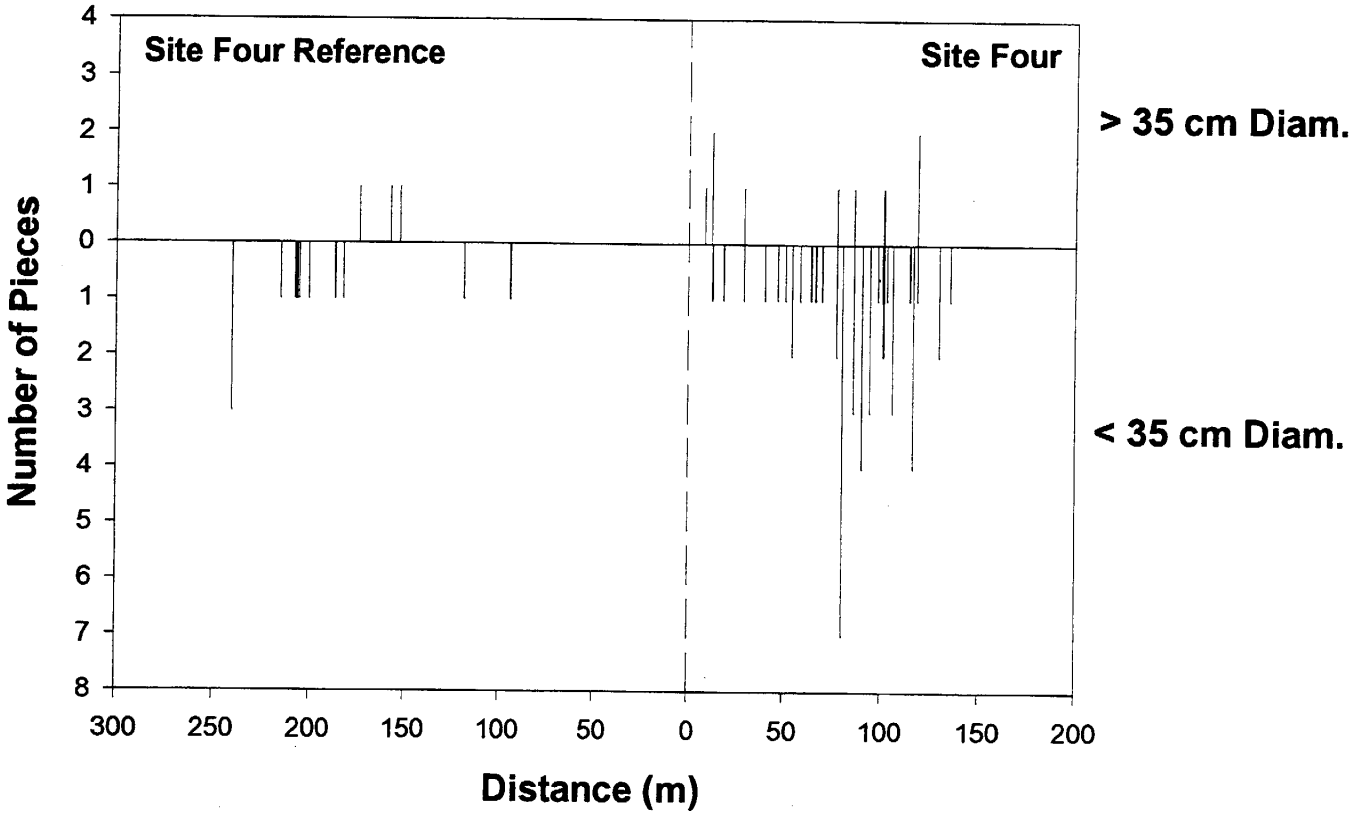

Figure 28. Distribution and number of trees in site four and site four reference. Dotted vertical line represents delineation between site and reference section.

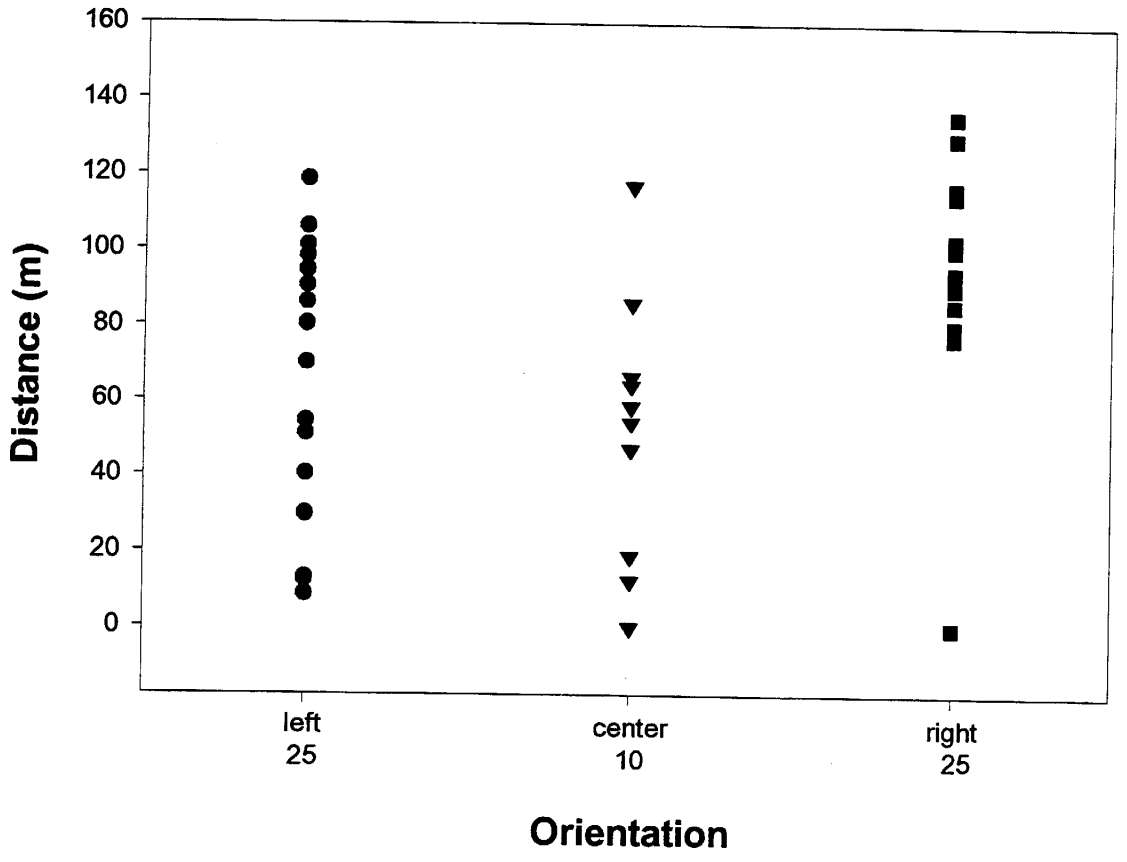

Figure 29. Orientation of trees at site four (main channel) in relation to stream channel. Numbers below orientation represent number of trees found in these areas.

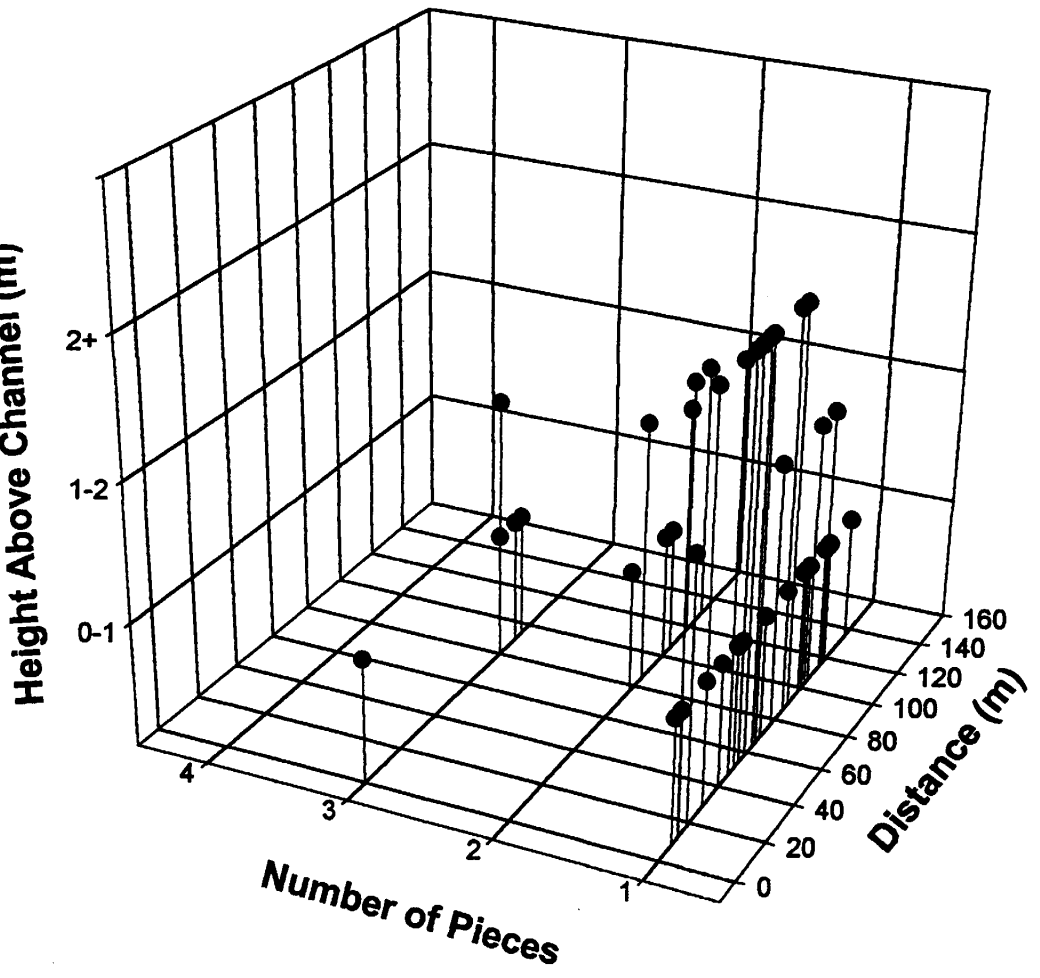

Figure 30. Height above stream channel for each tree in site four (left fork).

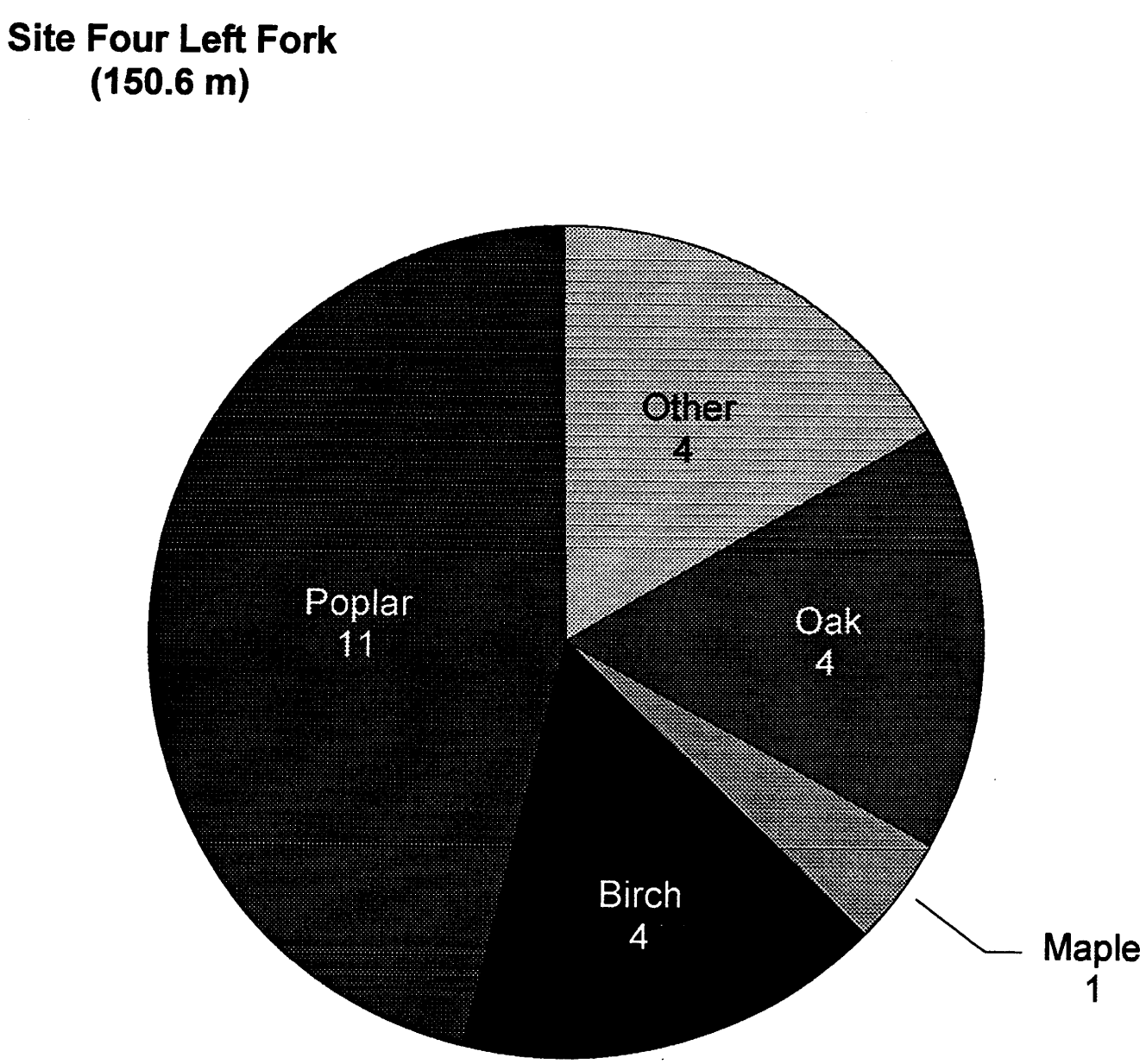

Figure 31. Species distribution of trees in site four (left fork).

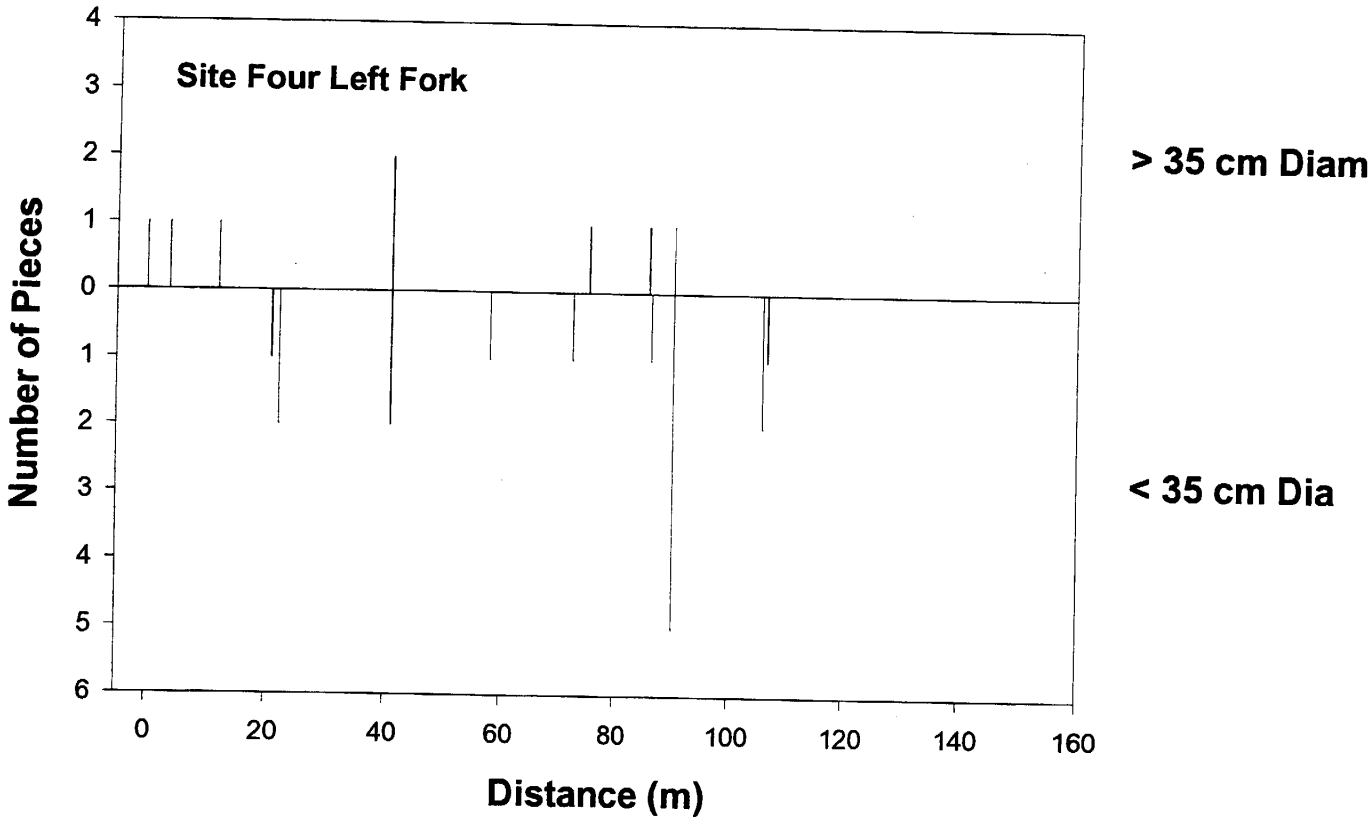

Figure 32. Distribution and number of trees in site four (left fork).

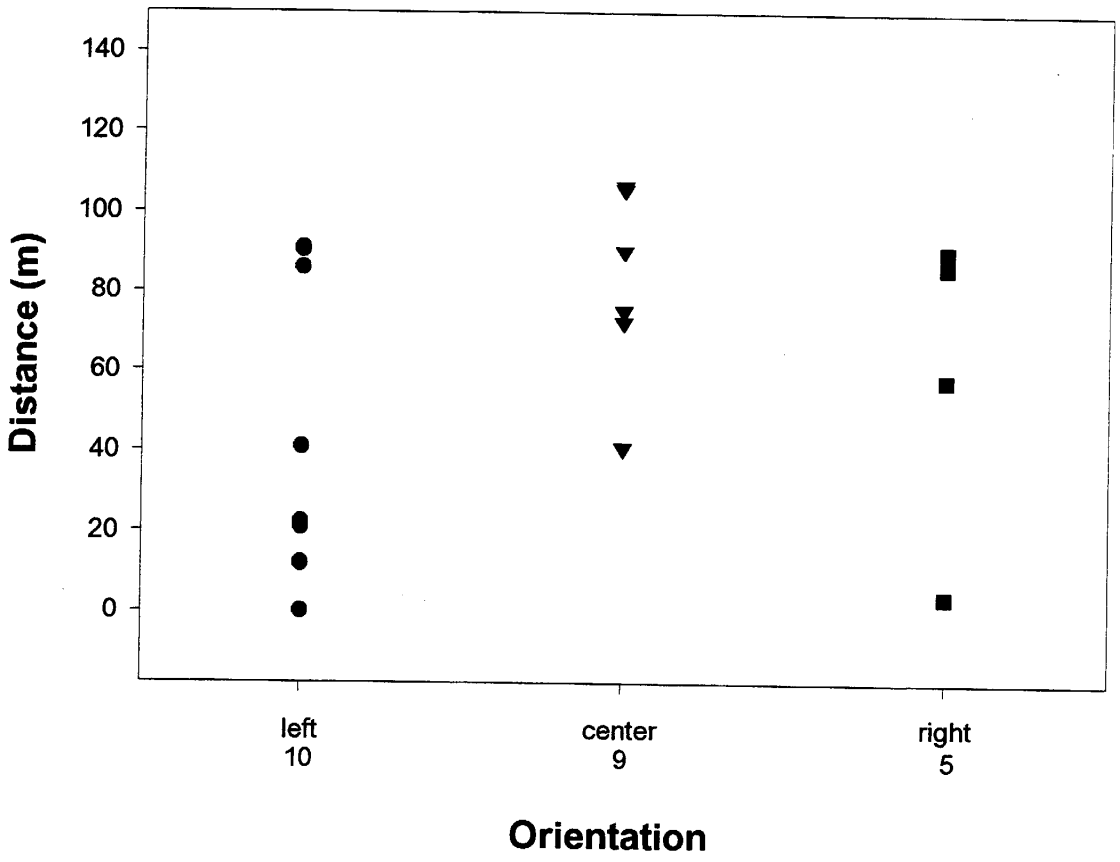

Figure 33. Orientation of trees at site four (left fork) in relation to the stream channel. Numbers below orientation represent number of trees found in these areas.

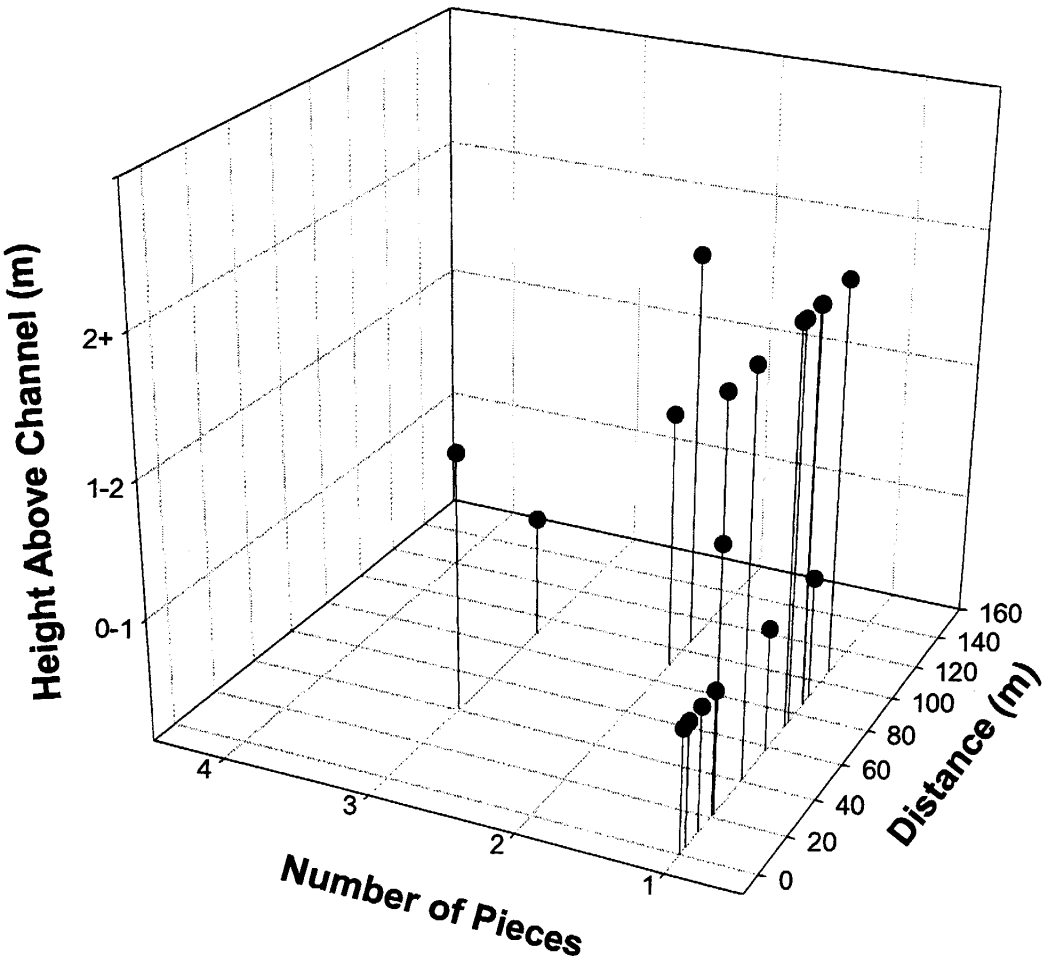

Figure 34. Height above stream channel for each tree in site four (Left Fork).

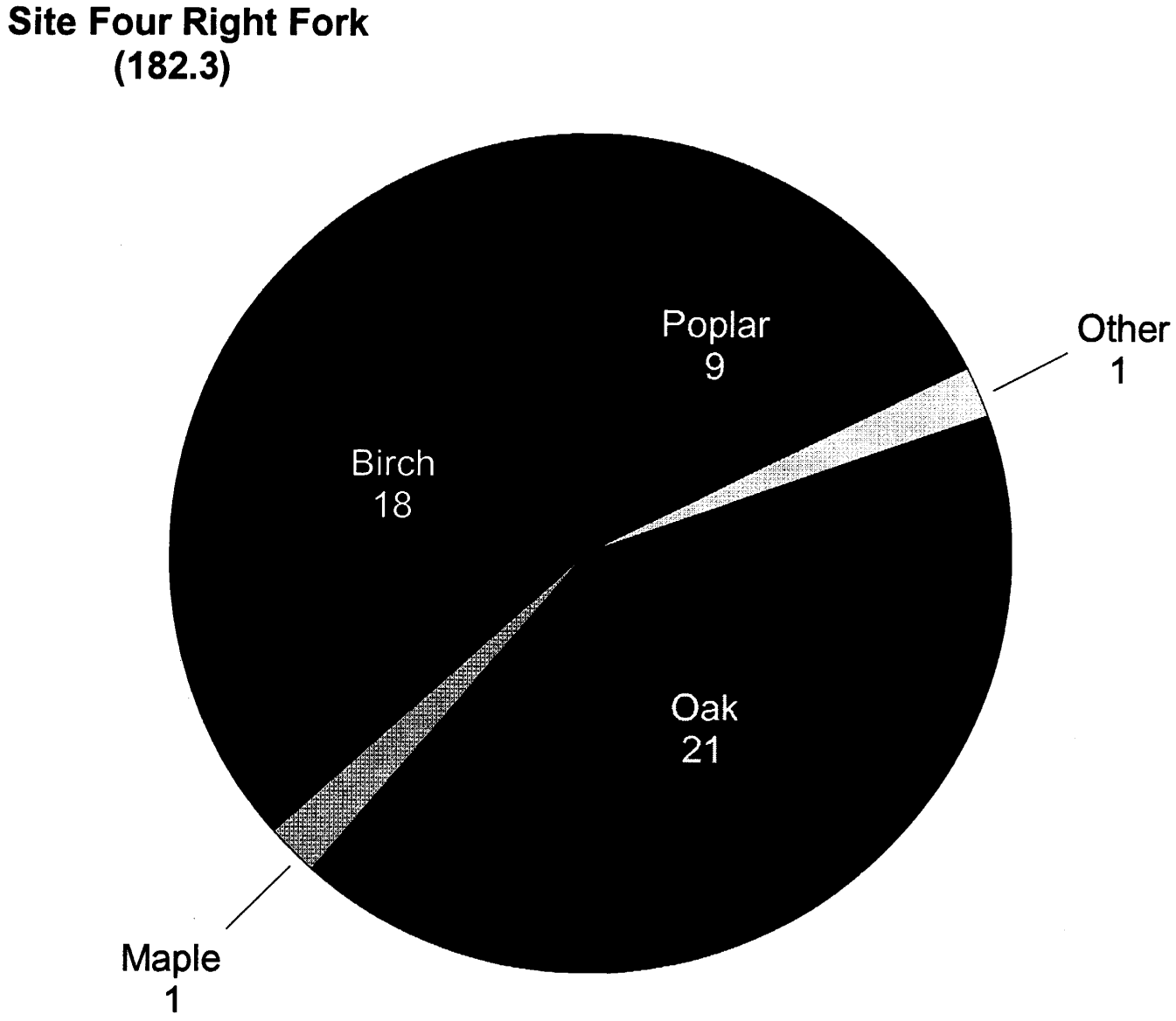

Figure 35. Species distribution of trees in site four (right fork).

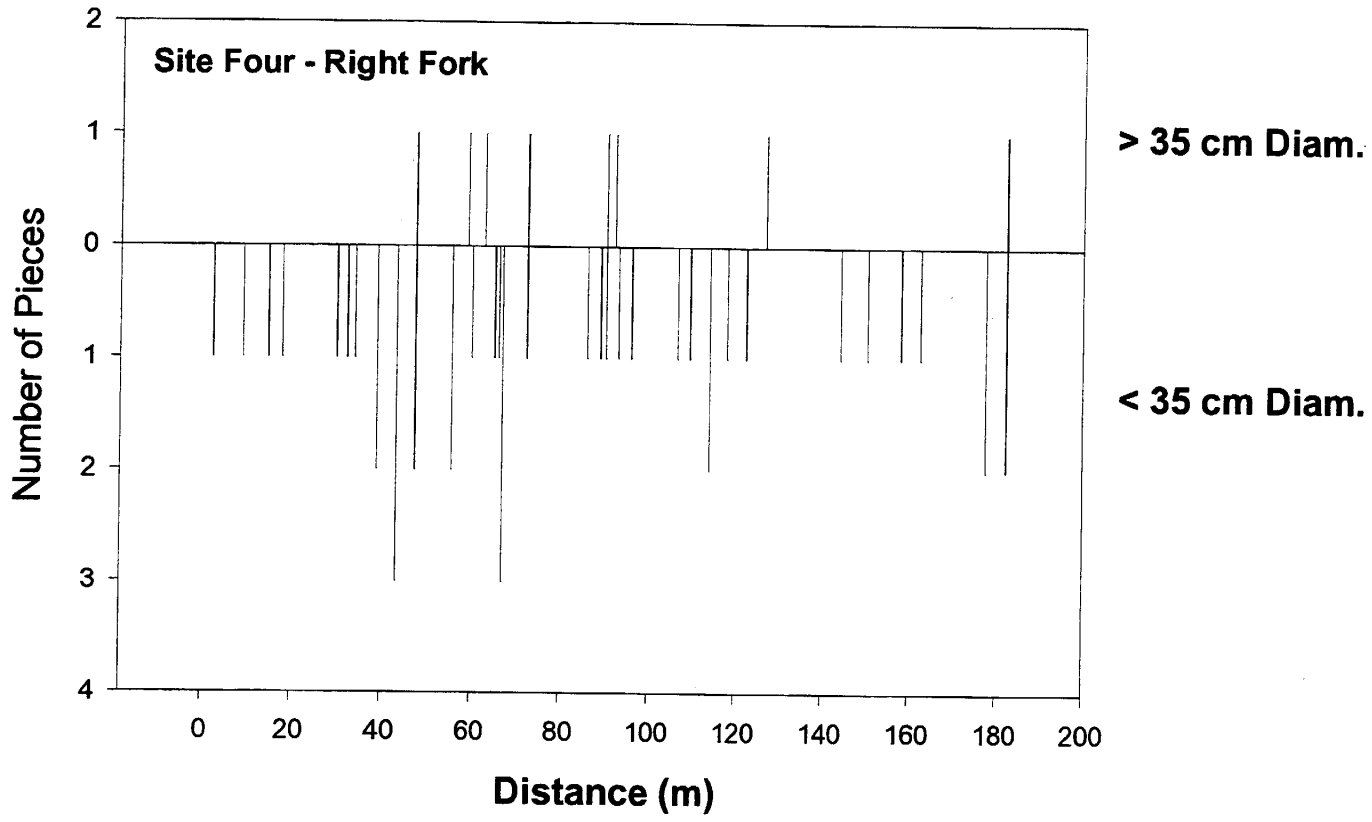

Figure 36. Distribution and number of trees in site four (right fork).

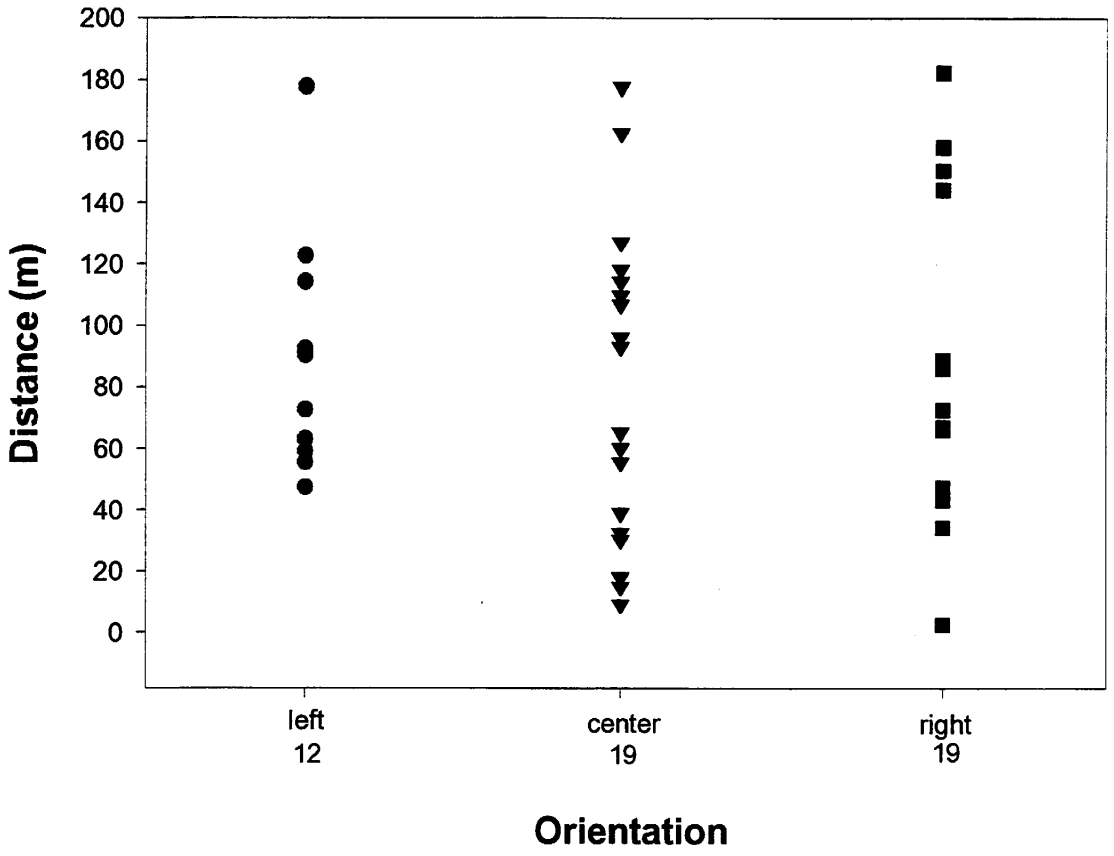

Figure 37. Orientation of trees at site four (right fork) in relation to stream channel. Numbers below orientation represent number of trees found in these areas.

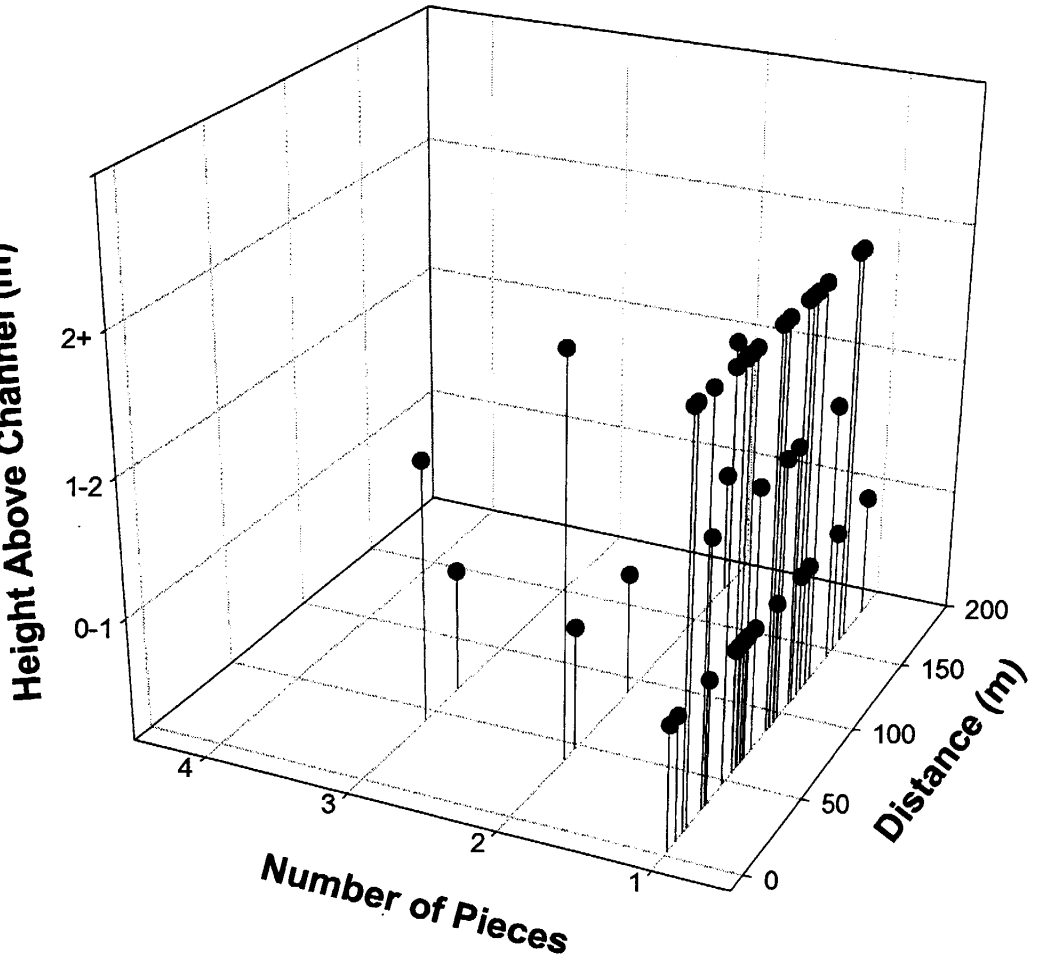

Figure 38. Height above stream channel for each tree in site four (Right Fork).

Site One

Table 1. All trees measured in site one, unnamed tributary of Chimney Rock Fork

Scientific Name	Common Name	No.	Mean Diameter (cm)	Max Diameter (cm)	Min Diameter (cm)
Betula sp.	Birch	10	32	55	20
Magnolia sp.	Magnolia	5	34	55	20
Acer sp.	Maple	21	29	85	20
Quercus sp.	Oak	37	39	60	20
	Other	11	27	40	20
Liriodendron sp.	Poplar	58	34	55	20
Total		**142**			

Site Two

Table 2. All trees measured in site two, unnamed tributary of Chimney Rock Fork

Scientific Name	Common Name	No.	Mean Diameter (cm)	Max Diameter (cm)	Min Diameter (cm)
Betula sp.	Birch	62	28	50	20
Magnolia sp.	Magnolia	7	23	40	20
Quercus sp.	Oak	62	38	80	20
	Other	7	31	45	20
Liriodendron sp.	Poplar	117	39	70	20
Total		**255**			

Site Three A

Table 3. All trees measured in site three A, unnamed tributary of Stony Creek.

Scientific Name	Common Name	No.	Mean Diameter (cm)	Max Diameter (cm)	Min Diameter (cm)
Magnolia sp.	Magnolia	1	20	20	20
Quercus sp.	Oak	6	22	30	20
	Other	1	40	40	40
Liriodendron sp.	Poplar	12	47	75	20
Total		**20**			

Site Three B

Table 4. All trees measured in site three B, unnamed tributary of Stony Creek.

Scientific Name	Common Name	No.	Mean Diameter (cm)	Max Diameter (cm)	Min Diameter (cm)
Betula sp.	Birch	4	29	40	25
Magnolia sp.	Magnolia	1	20	20	20
Acer sp.	Maple	1	20	20	20
Quercus sp.	Oak	14	36	60	25
	Other	13	37	60	25
Liriodendron sp.	Poplar	38	41	70	20
Total		**71**			

Site Three C

Table 5. All trees measured in site three C, unnamed tributary of Stony Creek.

Scientific Name	Common Name	No.	Mean Diameter (cm)	Max Diameter (cm)	Min Diameter (cm)
Betula sp.	Birch	1	20	20	20
Acer sp.	Maple	2	20	20	20
Quercus sp.	Oak	11	30	50	20
	Other	1	40	40	40
Liriodendron sp.	Poplar	45	35	50	25
Total		**60**			

Site Four Main Channel

Table 6. All trees measured in site four main channel, unnamed tributary of Staunton Creek.

Scientific Name	Common Name	No.	Mean Diameter (cm)	Max Diameter (cm)	Min Diameter (cm)
Betula sp.	Birch	18	23	40	20
Acer sp.	Maple	1	25	25	25
Quercus sp.	Oak	21	28	45	20
	Other	1	20	20	20
Liriodendron sp.	Poplar	9	26	35	20
Total		**50**			

Site Four Left Fork

Table 7. All trees measured in site four left fork, unnamed tributary of Staunton Creek.

Scientific Name	Common Name	No.	Mean Diameter (cm)	Max Diameter (cm)	Min Diameter (cm)
Betula sp.	Birch	4	21	25	20
Acer sp.	Maple	1	20	20	20
Quercus sp.	Oak	4	31	45	20
	Other	4	40	50	35
Liriodendron sp.	Poplar	11	28	40	20
Total		**24**			

Site Four Right Fork

Table 8. All trees measured in site four right fork, unnamed tributary of Staunton Creek.

Scientific Name	Common Name	No.	Mean Diameter (cm)	Max Diameter (cm)	Min Diameter (cm)
Betula sp.	Birch	24	27	45	20
Acer sp.	Maple	1	20	20	20
Quercus sp.	Oak	19	29	45	20
Liriodendron sp.	Poplar	16	28	40	20
Total		**60**			